This invention relates to hand-held hydraulic drills and one of its objects is, of course, to provide an improved drill of this type.

Another object of the invention is to provide an improved hand-held hydraulic drill wherein hydraulic fluid being supplied through a conduit to drive the motor of the drill may be by-passed to an exhaust conduit under the control of a valve operated manually against the pressure of the hydraulic fluid being supplied to operate the drill.

Another object of the invention is to provide improved structure in a hand-held hydraulic drill by which the foregoing object may be accomplished.

Another object of the invention is to provide improved structure in a hand-held hydraulic drill whereby any hydraulic fluid which may leak or seep from the hydraulic motor into the motor housing will be exhausted therefore from the motor exhaust conduit.

Another object of the invention is to provide improved structure in a hand-held hydraulic drill motor apparatus whereby parts of the motor may be lubricated by hydraulic fluid obtained directly from the exhaust conduit of the motor.

Still another object of the invention is to provide improved structure in a hand-held hydraulic drill whereby an operator, when using the drill, pushes upon a control lever or operating means that acts against the pressure of the hydraulic fluid being supplied to the drill motor to close an exhaust valve in said conduit, thereby causing said fluid to operate the drill motor, and in which improved structure the operator preferably, but not necessarily, is unable to close or maintain said valve closed against excessive hydraulic pressure which would occur, for example, if the drill motor should become overloaded.

Other objects of the invention will appear hereinafter, the novel features and combinations being set forth in the appended claims.

In the accompanying drawings:

Fig. 1 is a view in section through a hand-held hydraulic drill including the features of the invention;

Figs. 2 and 3 are views in section, the views being taken on lines 2-2 and 3-3 of Fig. 1 respectively; and

Fig. 4 is a view in section of a portion of the drill, the view being taken on line 4-4 of Fig. 2.

The hand-held hydraulic drill shown in the drawings is of such size, weight and power that it may be used with facility in a coal mine, for example, for driving a coal boring auger bit of any type commonly employed for boring or drilling shot holes, for example, at any of various locations in the mine walls. While the drill is specifically described herein as used in a mine, it will be apparent that it may be employed with equal facility for driving any auger or other means ordinarily driven by such a drill for uses other than in a mine.

Referring now to Fig. 1 of the drawings, the hand-held hydraulic drill includes a generally cup-shaped housing 10 formed of aluminum to maintain the weight of the drill at a minimum. Housing 10 includes two integral axially aligned tapped sockets 11 at opposite sides thereof, each of which receives a threaded end of a light weight tubular handle 12 screwed therein and by which handles an operator may hold the drill while operating it. The front end of housing 10 is closed by an aluminum end cap 13 and its rear end is closed by an end element in the form of a removable brass manifold and/or port plate 14. Actually, the members 10, 13 and 14 all cooperate to form a complete housing 15 for a rotary hydraulic motor 16.

Motor 16 includes a drive shaft 17 carried at its rear end in a needle type roller bearing 18 mounted in a cup or socket 19 formed in the manifold and/or port plate 14. Shaft 17 is supported adjacent its front end in a double row ball thrust bearing 20 also mounted in the manifold and/or port plate 14 and the housing 15 for retaining hydraulic fluid under pressure within the housing 15. A felt seal ring 24 excludes dirt and other foreign matter from the space between the shaft 17 and the cap 13.

A cylindrical cylinder barrel or block 25 is mounted on shaft 17 for axial movement there along and it is connected to drive the shaft by a key 26. Cylinder barrel 25 includes a plurality of spaced cylinders 27 that rotate in a circular orbit about the longitudinal rotary axis of shaft 17. In each cylinder 27 there is a hollow piston 28. A spring 29 interposed between each piston 28 and its cylinder 27 urges the piston 28 axially outwardly of its cylinder, and as will be clearly seen from the following description, these springs 29 and cylinder barrel or block 25 against the manifold and/or port plate 14.

As the cylinder barrel or block 25 rotates the pistons 28, acting through shoes or pads 30 connected thereto through universal ball and socket joints, work upon and slide over a thrust race plate or ring 31 carried by the thrust bearing 22. It will be seen that because the race plate or ring 31 lies in a plane that intersects the axis of shaft 17 at an angle the pistons 28 can reciprocate in their cylinders 27 and work upon the race plate or ring 31 to drive the cylinder barrel or block 25 and the drive shaft 17.

Rotation of the thrust block or ring 22 is prevented by a tubular pin 32 which interconnects and interlocks aligned bores in the thrust block 22 and the end wall of housing 10 and which bores connect with a bore in cap 13 that leads to its interior adjacent the pressure-type shaft seal 23. The bore in the thrust block 22 that receives the tubular interlock pin 32 opens to the interior of the motor housing 15 through a channel 33 formed by the thrust block 22 and the race plate or ring 31. Hydraulic fluid, which is oil, within the complete housing 15 may circulate through these passageways and along the shaft 17 between it and the thrust block or ring 22 to lubricate the front bearing 20.

The front end of shaft 17 projects axially beyond the end cap 13 and it carries a socket or chuck 34, indicated in phantom in Fig. 1 of the drawings, by which an auger bit, not shown, may be attached to and driven by the drill.

The manifold and/or port plate 14 is machined from a brass casting and, in addition to forming a part of the complete motor housing 15, it also forms a part of the hydraulic motor 16. As previously mentioned, the cylinder barrel or block 25 is urged against the manifold and/or port plate 14 by the springs 29 in pistons.
3. Hydraulic fluid under pressure within the cylinders 27 also acts to urge the cylinder barrel or block 25 against the manifold 14 and into rotary sealing engagement with the cylinder 27 above. The circumferential face portion of the manifold 14 engaged by the end of the cylinder barrel 25 is carefully machined to a flat port face surface which mates with the flat end surface of the cylinder barrel 25 that slides upon it and is intersected by two arcuate ports 35 and 36 (see Fig. 3) over which ports 37 (see Fig. 1) form the cylinder 25, one at each end of a cylinder 27, align and pass as the cylinder barrel 25 rotates with respect to the manifold and/or port plate 14. Port 35 is the high pressure input port through which hydraulic fluid under high pressure is admitted to the cylinders 27 and port 36 is the low pressure port through which hydraulic fluid is discharged from the cylinders 27 at a lower pressure.

The manifold and/or port plate 14 also includes a conduit 38 (see Figs. 1 and 2) through which hydraulic fluid under high pressure supplied from an independent source, such as a pump, not shown, is fed to the manifold 14 and a low pressure conduit 39 (see Figs. 1 and 3) through which hydraulic fluid is discharged from the motor at a lower pressure. Hydraulic fluid is fed into the high pressure conduit 38 through a port 40 and hydraulic fluid is discharged from the low pressure or exhaust conduit 39 through a port 41. As clearly indicated in Fig. 2 of the drawings, ports 40 and 41 lie in a plane intersecting the axis of rotation of the drive shaft 17 whereby supply and exhaust hoses may be connected conveniently directly to the rear end of the drill. High pressure conduit 38 connects directly with the arcuate high pressure motor supply port 35 and the low pressure or exhaust conduit 39 connects directly with the arcuate low pressure or exhaust port 36.

As indicated most clearly in Fig. 1 of the drawings, at one place the high and low pressure conduits 38 and 39 are separated by a wall 42. Wall 42 is drilled and tapped to receive a threaded end of the tubular valve body element 43 of a control valve 44 which valve 44 is of very simple springless construction and which forms a closed conduit or by-pass 45 between the conduits 38 and 39. The valve body 43 extends through a bore in a wall of the manifold 14 and is sealed thereto by an O-ring. Valve body 43 may be removed from the manifold 14 by placing a wrench on its exposed end, unscrewing it from the wall 42 and withdrawing it from the manifold. A piston 46 which may be reciprocated in the central bore of the body 43 includes a conical valve face 47 which may be brought into engagement with a valve seat in the form of an annular shoulder formed integral with the body 43 to close the by-pass or port means 45 between the conduits 38 and 39, as indicated in Fig. 1 of the drawings. Piston 46 and body 43 are sealed together by an O-ring. Piston 46 also includes a head or face portion 48 which is subject to the pressure of the hydraulic fluid in the high pressure supply conduit 38 which pressure, of course, tends at all times to open the valve.

Piston 46 is moved manually against the pressure of the hydraulic fluid within the conduit 38 to close the by-pass 45 by an operating lever or handle 49 fulcrumed on a pivot pin carried in an ear 50. The one of the handle bosses or pockets 11. One end of the operating handle or lever 49 forms an arcuate abutment 51 adapted to engage the end of a cap screw 52 threaded into the exposed end of piston 46 and locked thereto by a locknut 53.

Operating handle or lever 49 is arranged and positioned with respect to the adjacent handle 12 so that an operator, when holding the drill by its handles 12 and using it to bore a hole in a mine room wall, for example, will push upon the handle or operating lever 49 to force the drill toward the mine wall and simultaneously to move piston 46 against the pressure of the hydraulic fluid in the high pressure conduit 38. It will be seen that should the hydraulic drill motor 16 become over loaded or stalled the increased pressure of the hydraulic fluid in the high pressure conduit 38 acting upon the piston head or face 49 will overcome the pressure or force exerted by the operator on the operating handle or lever 49 and that valve 44 will be opened by said hydraulic pressure to permit hydraulic fluid to flow from conduit 38 through the by-pass 45 to the conduit 39 from which it will be exhausted from the drill.

It is well known that in a hydraulic motor of the type herein described there is a certain amount of leakage or seepage of hydraulic fluid between the port plate and the cylinder barrel and between the pistons and cylinders, which hydraulic fluid passes into the interior of the complete motor housing 15. In prior hydraulic drills it has been necessary to provide a drain usually in the form of a flexible hose for draining this hydraulic fluid from the complete motor housing. By this invention the necessity of a third or drain hose for the drill is eliminated.

As previously set forth the rotary shaft 17 is sealed to the complete motor housing 15 by the pressure type seal 23 to prevent hydraulic fluid under pressure within the housing 15 from escaping therefrom along the shaft 17. In the present drill hydraulic fluid which leaks or seeps from the motor 16 into the housing 15 is exhausted therefrom through a conduit or port 54 (see particularly Fig. 4) in the manifold or port plate 14 which connects the interior of the housing 15 directly to the low pressure or exhaust conduit 39. There is another conduit or port 55 which connects the low pressure or exhaust conduit 39 directly with the cup or socket 19 in the manifold 14 in which the roller bearing 18 is carried whereby hydraulic fluid may flow from said conduit 39 to lubricate said bearing 18.

It will be seen that when the high pressure conduit 38 is connected to receive hydraulic fluid from any source of hydraulic fluid under pressure, the pressure of this fluid will open the control valve 44 and the fluid will flow from conduit 38 through the by-pass 45 to the low pressure or exhaust conduit 39 to be exhausted from the drill and that, of course, when said fluid is being thus by-passed the hydraulic motor will be inoperative. When it is desired to cause the hydraulic motor 16 to operate, the operating handle or lever 49 is moved manually to force the piston 46 against the hydraulic fluid within the conduit 38 to close the by-pass 45 and, as its tapered valve face 47 and head 48 begin to restrict the by-pass, some of the hydraulic fluid in conduit 38 will begin to flow through the motor 16 to cause it to operate. When the valve 44 is fully closed, of course, all the hydraulic fluid entering conduit 38 will be directed through port 35 to operate the motor 16.

It will also be seen that the interior of the complete motor housing 15 is at all times subject to the pressure of the hydraulic fluid within the low pressure or exhaust conduit 39 since this conduit opens into the interior of the housing through the conduit 54. Because of this, leakage or seepage of hydraulic fluid from the hydraulic motor may be reduced since the pressure within the housing 15 will be greater than atmospheric pressure. The motor housing 15 will always contain sufficient hydraulic fluid to lubricate the motor adequately.

Obviously those skilled in the art may make various changes in the details and arrangement of parts without departing from the spirit and scope of the invention as defined by the claims hereto appended, and applicant therefore wishes not to be restricted to the precise construction herein disclosed.
Having thus described and shown an embodiment of the invention, what it is desired to secure by Letters Patent of the United States is:

1. A hand-held hydraulic drill including means forming a housing, a rotary cylinder barrel in said housing, pistons in said cylinder barrel, drive shaft means rotated by said cylinder barrel extending through said housing, a pressure type fluid seal interposed between said drive shaft and said housing, a thrust race means in said housing at one end of said cylinder barrel against which said pistons work, port plate means at the other end of said cylinder barrel including a high pressure port through which hydraulic fluid is admitted to said cylinder and a low pressure port through which hydraulic fluid is exhausted from said cylinders as the latter pass thereover, means forming a high pressure conduit leading to said high pressure port and a low pressure conduit leading from said low pressure port, conduit means interconnecting said high and low pressure conduit means, a manually operable valve for closing said last named conduit means, and means forming a passageway interconnecting said low pressure conduit means and the interior of said housing.

2. A hand-held hydraulic drill including means forming a housing, a rotary cylinder barrel in said housing, pistons in said cylinder barrel, a thrust race means in said housing at one end of said cylinder barrel against which said pistons work, port plate means at the other end of said cylinder barrel including a high pressure port through which hydraulic fluid is admitted to said cylinders and a low pressure port through which hydraulic fluid is exhausted from said cylinders as the latter pass thereover, means forming a high pressure conduit leading to said high pressure port and a low pressure conduit leading from said low pressure port, conduit means interconnecting said high and low pressure conduit means for flow of the hydraulic fluid from the high pressure conduit to the low pressure conduit by-passing the cylinders, and a manually operable valve for closing said interconnecting conduit means and causing the hydraulic fluid to flow to the cylinders from the high pressure conduit, said valve including a piston movable against hydraulic pressure in said high pressure conduit means to close said interconnecting conduit means whereby hydraulic fluid under pressure in said high pressure conduit means tends to open said valve.

3. A hand-held hydraulic drill including means forming a housing, a rotary cylinder barrel in said housing, pistons in said cylinder barrel, a thrust race means in said housing at one end of said cylinder barrel against which said pistons work, port plate means at the other end of said cylinder barrel including a high pressure port through which hydraulic fluid is admitted to said cylinders and a low pressure port through which hydraulic fluid is exhausted from said cylinders as the latter pass thereover, means forming a high pressure conduit leading to said high pressure port and a low pressure conduit leading from said low pressure port, conduit means interconnecting said high and low pressure conduit means for flow of the hydraulic fluid from the high pressure conduit to the low pressure conduit to the cylinders and thence to the low pressure conduit.

4. In a hand-held hydraulic drill, means forming a motor housing in which a hydraulic motor is housed, closure means closing one end of said housing forming a high pressure conduit through which hydraulic fluid is supplied to said motor, a low pressure conduit through which hydraulic fluid is exhausted from said motor, conduit means interconnecting said high and low pressure conduits, conduit means leading from said low pressure conduit to the interior of said housing whereby fluid leaked from said motor into said housing may be exhausted from the latter into said low pressure conduit, means forming a passageway interconnecting said low pressure conduit means and the interior of said housing, and means forming a passageway interconnecting said low pressure conduit means and the interior of said housing.

5. In a hand-held hydraulic drill, means forming a motor housing in which a hydraulic motor is housed, closure means closing one end of said housing forming a high pressure conduit through which hydraulic fluid is supplied to said motor, a low pressure conduit through which hydraulic fluid is exhausted from said motor, conduit means interconnecting said high and low pressure conduits, conduit means leading from said low pressure conduit to the interior of said housing whereby fluid leaked from said motor into said housing may be exhausted from the latter into said low pressure conduit, means forming a passageway interconnecting said low pressure conduit means and the interior of said housing.

6. In a hand-held hydraulic drill, means forming a motor housing in which a hydraulic motor is housed, closure means closing one end of said housing forming a high pressure conduit through which hydraulic fluid is supplied to said motor, a low pressure conduit through which hydraulic fluid is exhausted from said motor, conduit means interconnecting said high and low pressure conduits, conduit means leading from said low pressure conduit to the interior of said housing whereby fluid leaked from said motor into said housing may be exhausted from the latter into said low pressure conduit, a second conduit means leading from said low pressure conduit means which interconnect said high and low pressure conduits, conduit means leading from said low pressure conduit to the interior of said housing whereby fluid leaked from said motor into said housing may be exhausted from the latter into said low pressure conduit, a second conduit means leading from said low pressure conduit through which hydraulic fluid may flow to lubricate parts of said motor, and a manually operable valve means for closing said last named conduit means which interconnect said high and low pressure conduits, valve means including a piston movable against hydraulic pressure in said high pressure conduit means whereby hydraulic fluid under pressure in said high pressure conduit means tends to open said valve to render said motor normally inoperative.

7. In a hand-held hydraulic drill, means forming a motor housing in which a hydraulic motor is housed, closure means closing one end of said housing forming a high pressure conduit through which hydraulic fluid is supplied to said motor, a low pressure conduit through which hydraulic fluid is exhausted from said motor, conduit means interconnecting said high and low pressure conduits, conduit means leading from said low pressure conduit to the interior of said housing whereby fluid leaked from said motor into said housing may be exhausted from the latter into said low pressure conduit, and valve means for closing said conduit means which interconnect said high and low pressure conduits.

8. In a hand-held hydraulic drill, means forming a motor housing in which a hydraulic motor is housed, closure means closing one end of said housing forming a high pressure conduit through which hydraulic fluid is supplied to said motor, a low pressure conduit through which hydraulic fluid is exhausted from said motor, conduit means interconnecting said high and low pressure conduits, a valve means for closing said last named conduit means, said valve means including a piston movable against hydraulic pressure in said high pressure conduit whereby hydraulic fluid under pressure in said high pressure conduit tends to open said valve to render said motor normally inoperative, handle means for said drill, a lever for moving said valve piston toward its closed position, and means mounting said lever adjacent said handle whereby an operator may push upon said lever against the pressure of the hydraulic fluid acting on said
piston to close said valve and cause operation of the motor.

9. In a hand-held hydraulic drill, means forming a motor housing in which a hydraulic motor is housed, closure means closing one end of said housing forming a high pressure conduit connected to said motor and through which hydraulic fluid is supplied to said motor, a low pressure conduit connected to said motor and through which hydraulic fluid is exhausted from said motor, conduit means interconnecting said high and low pressure conduits for flow of the hydraulic fluid from the high pressure conduit to the low pressure conduit bypassing the motor, a valve means for closing said last named conduit means, said valve means including a piston movable against hydraulic pressure in said high pressure conduit whereby hydraulic fluid under pressure in said high pressure conduit tends to open said valve to render said motor normally inoperative, a lever for moving said valve piston toward its closed position for flow of the hydraulic fluid from the high pressure conduit to the motor, and means mounting said lever whereby an operator may push it against the pressure of the hydraulic fluid acting on said piston to close said valve and cause operation of the motor.

10. In a hand-held hydraulic drill, a hydraulic motor, means forming a high pressure conduit connected to said motor and through which hydraulic fluid is supplied to said motor, means forming a low pressure conduit connected to said motor and through which hydraulic fluid is exhausted from said motor, conduit means interconnecting said high and low pressure conduit means for flow of the hydraulic fluid from the high pressure conduit to the low pressure conduit bypassing the motor, a valve means for closing said last named conduit means, said valve means including an element movable against hydraulic pressure in said high pressure conduit whereby hydraulic fluid under pressure in said high pressure conduit tends to open said valve to render said motor normally inoperative, a lever for moving said valve element towards its closed position for flow of the hydraulic fluid from the high pressure conduit to the motor, and means mounting said lever whereby an operator to use said drill will push upon said lever against the pressure of the hydraulic fluid acting on said valve means to close said valve and cause operation of the motor.

11. In a hand-held hydraulic drill, a hydraulic motor, means forming a high pressure conduit connected to said motor and through which hydraulic fluid is supplied to said motor, means forming a low pressure conduit connected to said motor and through which hydraulic fluid is exhausted from said motor, valve means interconnecting said high and low pressure conduit means, said valve means including means responsive to pressure in said high pressure conduit for opening said valve means to render said motor normally inoperative, operating means movable to overcome the pressure acting on said pressure responsive means to close the valve means for flow of the hydraulic fluid from the high pressure conduit to said motor, and means mounting said operating means whereby an operator to use said drill will push upon said operating means against the pressure of the hydraulic fluid in said high pressure conduit to close said valves and cause operation of the motor.

12. In a hydraulic motor, means forming a motor housing, a motor within said housing, high pressure conduit means for conducting hydraulic fluid under pressure to said motor to drive it, an exhaust conduit means through which said hydraulic fluid is discharged from said motor and housing, and conduit means connecting said exhaust conduit and the interior of said motor housing whereby hydraulic fluid leaked from said motor into said housing may flow from the latter into said exhaust conduit.

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