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[54] **HYDRAULIC JET DRILLS**
10 Claims, 3 Drawing Figs.

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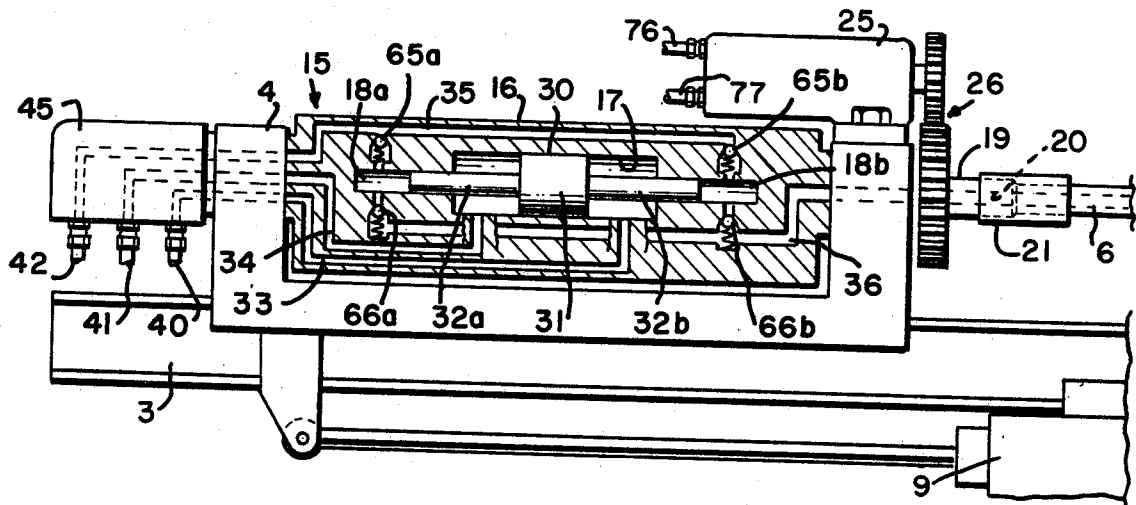
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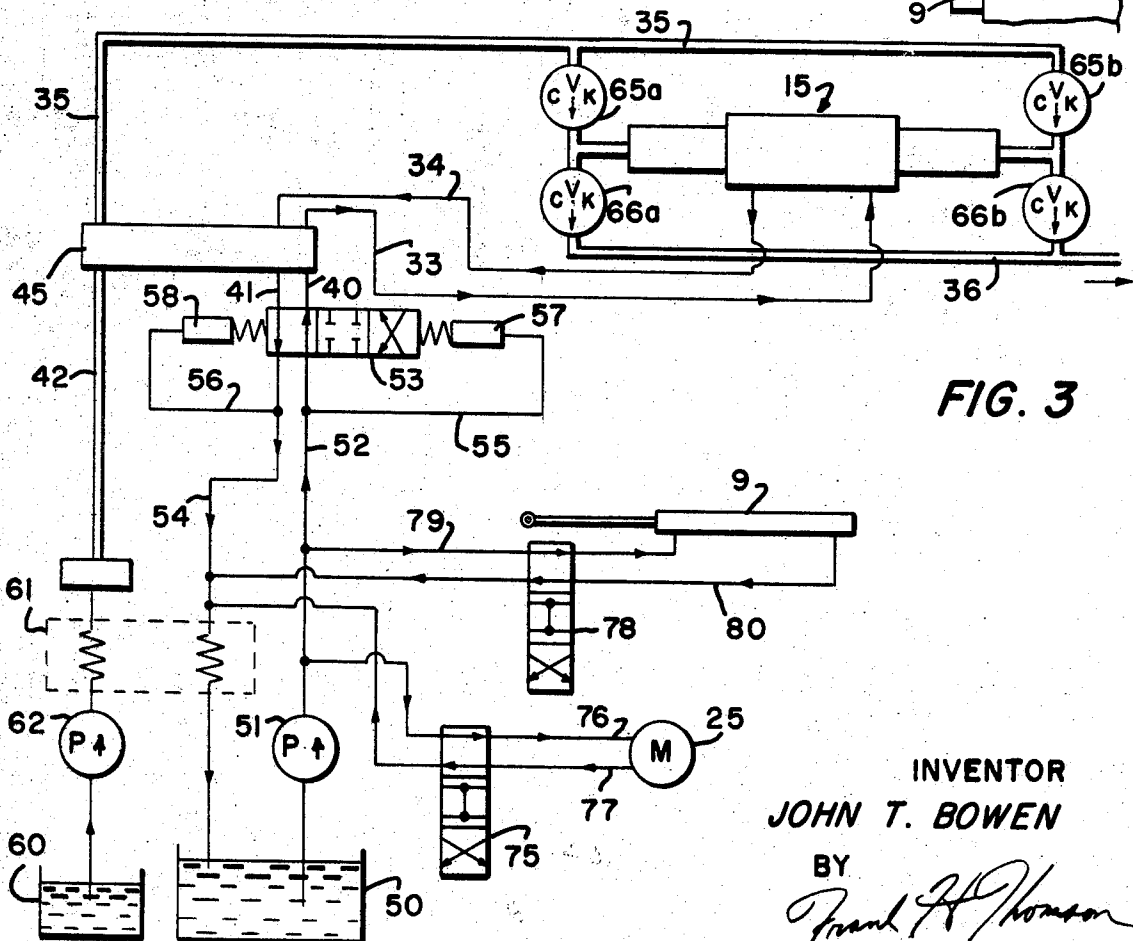
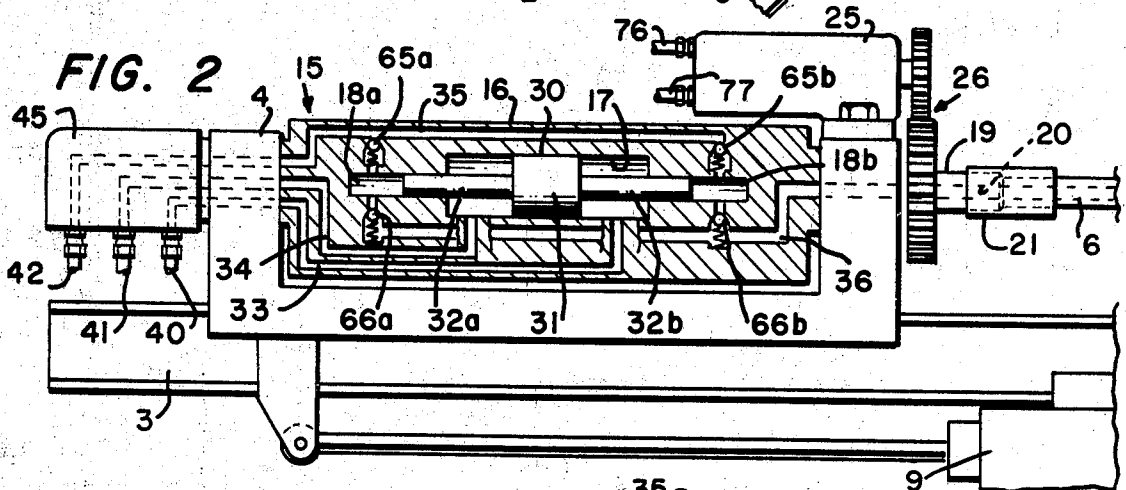
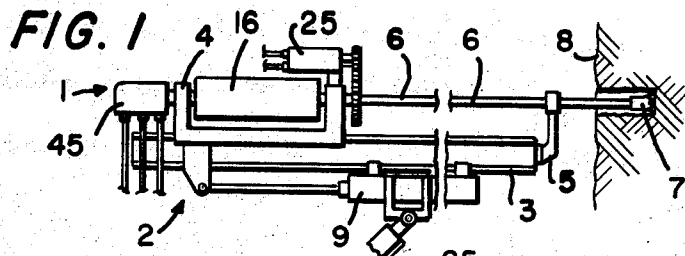
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ABSTRACT: A rock-drilling apparatus which employs the principle of a high-pressure hydraulic jet to drill the hole. A double-acting intensifier is rotatably mounted on a frame and is adapted to have a hollow drill pipe connected thereto. The intensifier continuously supplies high-pressure fluid to the bottom of the hole for boring the hole. A swivel provides a connection for fluid pressure conduits to permit hydraulic fluid to be conducted to the intensifier.





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HYDRAULIC JET DRILLS

BACKGROUND OF THE INVENTION

This invention relates to hydraulic jet drills and in particular to hydraulic jet drills adapted to bore long holes of small diameter.

In many mining operations, it would be desirable to drill long holes in the area of 150 feet in depth and of a diameter on the order of 2 inches. With present mining techniques employing rotary-percussive drills, it is difficult to bore small diameter long holes because conventional drill rods are not rigid enough to permit a straight hole to be bored. It would therefore be desirable to adapt the principles of hydraulic jet drilling recently developed in the field of oil well drilling to bore holes in mining and construction operations.

Present hydraulic jet drilling apparatus is limited by the ability of present sealing means to withstand high hydraulic pressures. In long hole drilling it is necessary to rotate the drill bit to insure proper coverage of the hole bottom. With prior arrangements, it is necessary to provide ultrahigh-pressure seals between relatively rotating parts. Such seals are expensive and have a relatively short life.

SUMMARY

It is therefore the principal object of this invention to provide a hydraulic jet drill which eliminates the necessity of employing ultrahigh-pressure seals between relatively rotating parts.

It is a further object of this invention to provide a hydraulic jet drill which insures a continuous supply of fluid under pressure to the bottom of the hole being drilled.

It is a still further object of this invention to provide a hydraulic jet drill which is simple in construction and employs a minimum of moving parts.

The foregoing and other objects will be carried out by providing apparatus for drilling a hole by means of a hydraulic jet comprising: a frame; intensifier means rotatably mounted on said frame and having high- and low-pressure sides; a shank piece having a bore therethrough operatively connected to said intensifier and adapted to have a hollow drill rod connected thereto; means for rotating said intensifier means and said shank piece; first conduit means for conducting fluid under pressure to the low-pressure side of the intensifier; second conduit means for conducting fluid to the high-pressure side of the said intensifier; and third conduit means for flow connecting the high-pressure side of said intensifier and the bore in said shank piece so that fluid under pressure will be conducted from the high-pressure side of said intensifier to the working face of a hole being drilled.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be described in connection with the annexed drawing wherein:

FIG. 1 is a side elevation of a rock drill employing one embodiment of the present invention;

FIG. 2 is a fragmentary detail of the drill of the present invention; and

FIG. 3 is a schematic diagram of the conduits and valving for supplying fluid to the drill of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Although the invention will be described as a drill for long holes of small diameter, it may be used in oil well drilling or other applications. Referring to the drawing and in particular to FIG. 1, there is shown a drilling machine generally indicated at 1 supported on a mounting generally indicated at 2. The mounting includes a drill guide 3 and a frame 4 slidably mounted on the drill guide. A centralizer 5 is connected to the guide 3 for maintaining a hollow drill rod 6 properly centered. A hydraulic jet type drill bit 7 is connected to the outer end of the rod 6 for boring a hole in the rock 8. A suitable piston-cylinder arrangement 9 is mounted on the drill guide for advancing and retracting the frame 4 relative to the drill guide.

A double-acting intensifier generally indicated at 15 is rotatably mounted on the frame 4. The intensifier includes a casing 16 which defines a first cylinder 17 and a pair of second, smaller diameter cylinders 18a and 18b connected to opposite ends of the cylinder 17; the cylinder 17 is the low-pressure side of the intensifier and the cylinders 18a and 18b constitute the high-pressure side of the intensifier. A shank piece 19 having a bore 20 therethrough is operatively connected to the intensifier 15 for rotation with the intensifier. The drill rod 6 is adapted to be connected to the shank piece 19 by any well known coupling 21. The intensifier 15 and shank piece 19 are rotated by means of a hydraulic motor 25 and suitable gearing 26. As will become apparent, because the intensifier and drill rod rotate together, the need for ultrahigh-pressure seals between relatively rotating parts has been eliminated.

A piston 30 is mounted for reciprocable movement within the intensifier 15 and includes a first diameter portion 31 and second reduced diameter portions 32a and 32b connected to opposite sides of the portion 31. The portion 31 is adapted to reciprocate in the cylinder 17 while the portions 32a and 32b are adapted to reciprocate in the cylinders 18a and 18b respectively.

First fluid pressure conduits 33 and 34 are provided in the intensifier casing 16 for conducting fluid under pressure to the cylinder 17 on opposite sides of the piston portion 31. Second conduit means 35 is positioned in the casing 16 for conducting fluid to the cylinders 18a and 18b. Third conduit means 36 flow connects the cylinders 18a and 18b with the bore 20 in the shank piece 19.

Conduits 40, 41 and 42 are flow connected to conduits 33, 34 and 35 respectively through a suitable swivel 45 which is mounted on the frame 4. The use of a swivel coupling eliminates the necessity of employing ultrahigh-pressure seals between relatively rotating parts. Although seals must be used between the rotating intensifier and the stationary swivel, the fluid in the conduits 33, 34, 35, 50, 41 and 42 is a comparatively low pressure. Seals which prevent leakage at the pressures encountered at this point are readily available.

Referring to FIG. 3, oil from a reservoir 50 is pumped by means of a pump 51 through a conduit 52 and a four-way valve 53 to either the conduit 40 or the conduit 41, depending upon the position of the valve 53. A conduit 54 returns oil from the valve 53 to the reservoir 50. This oil serves to reciprocate the piston 30. Pilot lines 55 and 56 extend between lines 52 and 54 and solenoids 57 and 58 for positioning the valve 53. Water is pumped from a reservoir 60 through a cooler 61 by means of a pump 62 to the conduit 42 and the conduit 35 to the cylinders 18a and 18b.

The operation of the device will now be described. When the valve 53 is in the position of FIG. 3, a hydraulic fluid such as oil, is pumped from the reservoir 50 through conduit 52 to conduit 40 at a predetermined pressure; e.g. 3,000 p.s.i. The oil passes through conduit 33 to the cylinder 17 where it acts on piston portion 31 to move piston 30 to the left in FIG. 2. Oil on the other side of piston portion 31 is returned to the reservoir 50 by way of passages 34 and 54 through cooler 61. At the same time, pump 62 moves water or other hydraulic fluid from reservoir 60 through cooler 61 to conduits 42 and 35, to pass through check valves 66a and 66b to fill cylinders 18a and 18b.

As the piston 30 moves to the left, the pressure in cylinder 18a is increased above the pressure of the oil. This pressure may be 15,000 p.s.i. depending on the difference in area between the piston portion 31 and the piston portion 32a. The increased pressure of the water in cylinder 18a overcomes check valve 66a and high-pressure fluid flows through conduit 36 to passage 20 in the coupling 19, through the bore in drill rod 6 and to the bottom of the hole being drilled.

As the piston 30 moves to the left, the pressure in line 54 will tend to increase and the pressure in line 52 will decrease. The pilot lines 55 and 56 will sense the pressure change and the valve 53 will be moved to the left in FIG. 3 so that incoming oil is now pumped through line 34 to move the piston 30 to

the right. The pressure of water in cylinder 18b is now increased and forced past check valve 66b into passage 36 and to the bottom of the hole being drilled. The check valve 65b prevents the water from passing back to the reservoir 60. As piston 30 moves to the right to pressurize the fluid in cylinder 18b, water will enter cylinder 18a. It should be readily apparent that the double acting intensifier permits a substantially continuous supply of high-pressure fluid down the hole.

If desired, other intensifier and fluid supply arrangements may be used. The important feature is the continuous supply of fluid to the bottom of the hole being drilled.

The motor 25 for rotating the drill steel and intensifier is connected to the lines 52 and 54 through a four-way valve 75 and conduits 76 and 77. The four-way valve 75 permits the motor to be rotated in either direction.

The piston-cylinder arrangement 9 is flow connection to the lines 52 and 54 through a four-way valve 78 by conduits 79 and 80 respectively. The valve 78 permits the frame 4, intensifier 15 and drill rod 6 to be advanced or retracted or held stationary.

From the foregoing it should be apparent that a hydraulic jet drill which employs relatively few moving parts has been provided. The need for ultrahigh-pressure seals between relatively rotating parts has been eliminated. High pressure fluid does not pass through a coupling between relatively rotating parts. The relatively rotating parts are subject only to relatively low pressures. A continuous supply of hydraulic fluid is conducted to the work face through the use of a double-acting intensifier. Long holes may be bored because no force is applied to the drill steel which will tend to cause bending of the drill steel. This will result in straighter long holes being drilled.

I claim:

1. Apparatus for drilling a hole by means of a hydraulic jet comprising:

a frame;

intensifier means rotatably mounted on said frame and having high- and low-pressure sides;

a shank piece having a bore therethrough operatively connected to said intensifier and adapted to have a hollow drill rod connected thereto;

means for rotating said intensifier means and said shank piece;

first conduit means for conducting fluid under pressure to the low-pressure side of said intensifier;

second conduit means for conducting fluid to the high-pressure side of said intensifier; and

third conduit means for flow connecting the high-pressure side of said intensifier and the bore in said shank piece so that fluid under pressure will be conducted from the high-pressure side of said intensifier to the working face of a hole being drilled.

2. The apparatus of claim 1 further comprising a first reservoir and said second conduit is connected to said reservoir and check valve means positioned in said second conduit for preventing fluid from flowing from the high-pressure side of said intensifier to said first reservoir.

3. The apparatus for claim 2 further comprising check valve means for positioned in said third conduit means for permitting fluid to flow from the high-pressure side of said intensifier only when the fluid on the high-pressure side exceeds a predetermined pressure.

4. The apparatus of claim 1 further comprising swivel means for operatively connecting said first and second conduit means to said intensifier means.

5. The apparatus of claim 4 wherein said intensifier is double acting.

6. The apparatus of claim 5 further comprising a mounting; said frame being mounted on said mounting; and means for advancing said frame relative to said mounting as the hole being drilled increases in depth.

7. Apparatus for drilling a hole by means of a hydraulic jet comprising:

a frame;

a casing defining first and second interconnected cylinders rotatably mounted on said frame;

said first cylinder having a diameter larger than said second cylinder;

first and second rigidly interconnected pistons mounted for reciprocal movement in said first and second cylinders;

a shank piece having a bore therethrough operatively connected to said casing;

first conduit means for conducting fluid to said first cylinder for reciprocating said first and second pistons;

second conduit means for conducting fluid to said second cylinder;

third conduit means flow connecting said second cylinder and the bore in said shank piece; and

a check valve positioned in said third conduit means for preventing fluid from flowing from the bore in said shank piece to said second cylinder and for permitting flow of fluid from said second cylinder to said bore only when the fluid in said second cylinder exceeds a predetermined pressure.

8. The apparatus of claim 7 further comprising means for rotating said casing and swivel means operatively connecting said first and second conduits to said casing.

9. The apparatus of claim 8 further comprising a mounting; said frame being slidably mounted on said mounting; and means for moving said frame relative to said mounting.

10. The apparatus of claim 9 wherein there are a pair of second cylinders and a pair of second pistons, each of said second cylinders being connected to said their conduit means.

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