

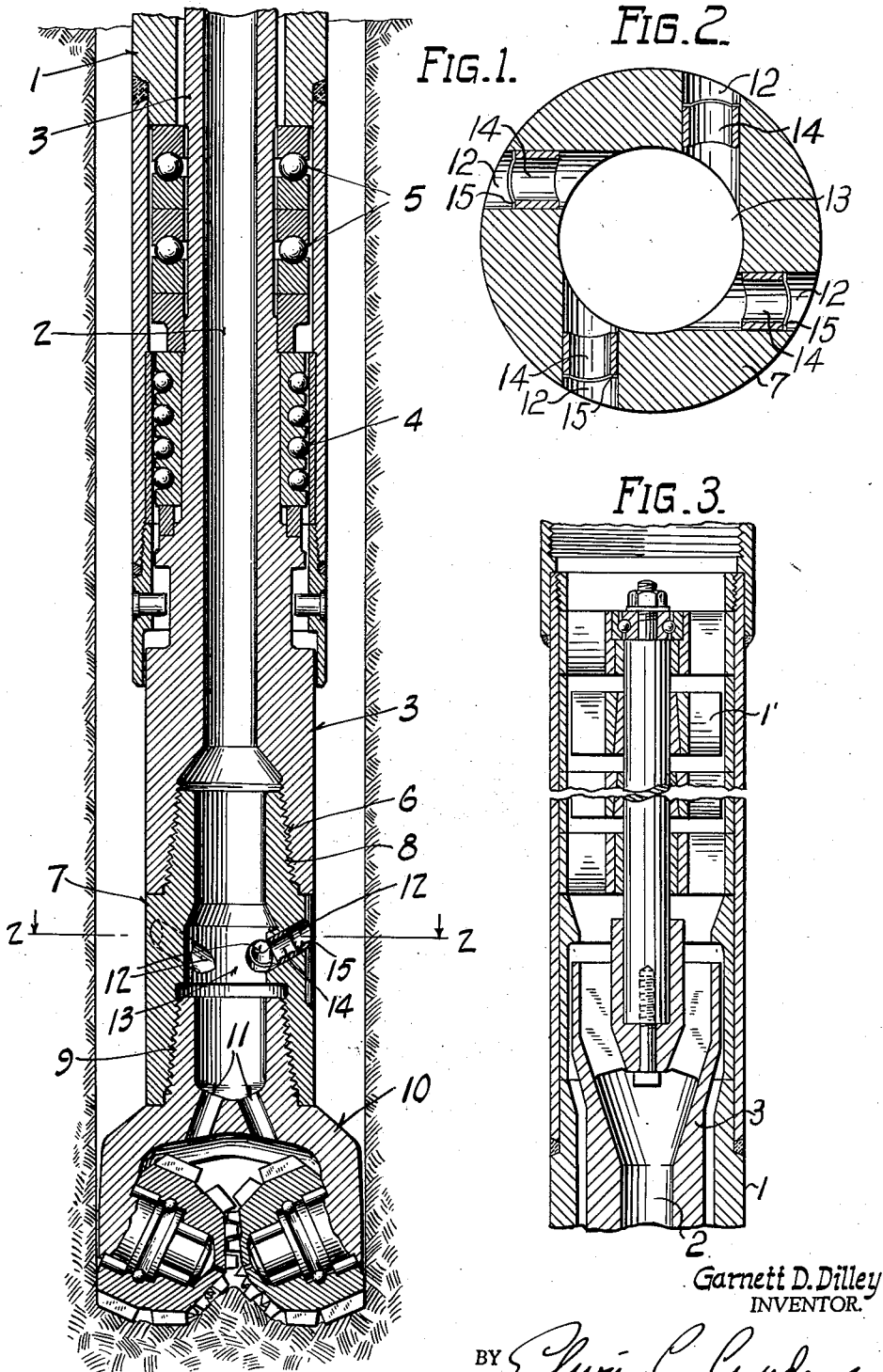
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TURBINE DRIVEN WELL DRILLING UNIT

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TURBINE DRIVEN WELL DRILLING UNIT

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4 Claims. (Cl. 255-4)

This invention relates to a turbine driven unit for drilling wells.

In drilling units of this kind, mud is pumped down through a hollow drill stem, through a hydraulic turbine to turn the drilling bit, and out through the bit to wash the cuttings up to the surface of the ground through the annular space between the bore hole and the drill stem.

One of the objects of this invention is to improve the operation of such drilling units by diverting a part of the mud stream from the drilling bit.

Another object of the invention is to provide means for splitting the stream of mud that comes from the hydraulic turbine, directing part of it through the rotary drilling bit, and diverting part upwards into the annular space between the drill stem and hole.

A further object of the invention is to bypass a part of the fluid driving the turbine from the drill bit and to discharge it into the hole in a manner to assist in the maintaining of the walls of the hole.

These and other objects of the invention will be clear from the following detailed description and the accompanying drawing in which:

Figure 1 is a longitudinal section through the lower portion of a drilling unit constructed in accordance with this invention;

Fig. 2 is a section on line 2-2 of Fig. 1; and

Fig. 3 is a side elevation of a turbine and drill operating in a well.

Referring to the drawing, the turbo-drilling unit has an outer casing 1 which houses a multiple stage, axial flow hydraulic turbine 1' driven by drilling mud pumped down through the hollow drill stem to which the unit is attached. Turbine 1' is illustrated in Fig. 3 and is preferably the same as that described and shown in Fig. 2 of Yost Patent No. 2,286,528, issued June 16, 1942, for Radial ball bearings, and assigned to the same assignee as the present application.

After passing through the turbine, the drilling mud is directed into the longitudinal passageway 2 in a hollow shaft 3 which is rotated by the turbine. Fig. 3 shows the upper end of the shaft 3 of Fig. 1. The shaft is supported by suitable radial bearings 4, a thrust bearing 5, and another radial bearing not shown in the drawing. At its lower end the shaft 3 has an internally threaded socket 6 for making connection to a connector 7 having external threads 8 for engagement with the internal threads in socket 6. The connector 7 has an internally threaded socket 9 for attachment to a rotary drilling bit 10. The particular

form of bit used constitutes no part of this invention and will be chosen so as to be suitable for use in the particular formation being drilled. Passages 11 in the bit direct drilling mud into the bore hole to sweep cuttings upward.

In rotary drilling with a rotary table which turns the drill stem and the drill bit with it, the function of the drilling mud is to carry the cuttings upward with it as the mud returns to the top of the bore hole, and to mud up the hole. The quantity of mud pumped is no greater than necessary, for a larger quantity results in useless expenditure of energy in the mud pumps. But in turbine drilling the quantity of mud pumped must be sufficient to drive the turbine and may be more than is needed for the other purposes. It has been found that the passage of too much mud through the drill bit has a number of unfortunate consequences.

Since the passages through the drill bit are necessarily of somewhat limited area, the velocity of the mud through them is high and results in erosion of the bit and cutters. Furthermore, an excessive quantity of mud creates a large pressure drop in the drill bit, and this drop is, of course, not available for driving the turbine. In addition, the mud that passes out through the drill bit must be reversed in direction and sent up the well. When a large quantity of mud is pumped through the drill bit, the upwardly directed force which it applies to the bit may decrease the pressure of the bit on the rock below the value that is appropriate for the formation being drilled.

These difficulties are avoided by the use of the present invention according to which only a part of the mud pumped to the turbine is passed through the drill bit. The remainder passes through passageways 12 in connector 7. These passageways preferably extend tangentially from the longitudinal passage 13 in connector 7, and slope upwards from the inside of the connector towards the outside. Bushings 14 of boron steel or other hardened material may be secured in the passages by welds 15 in order to protect them from erosion by the mud.

The passageways 12 should be laid out in accordance with the direction of rotation of the turbine so that the torque exerted by the reaction of the mud will be added to the turbine torque. The upward slope of the passages starts the mud which comes from the connector on its upward path in which it sweeps the drill cuttings up to the surface. Furthermore, the upward deflection of the mud leaving the connector exerts a down-

ward force which counterbalances, in part at least, the upward force exerted on the drilling unit by that part of the drilling mud which escapes through passages 11 in drill bit 10. The tangential and upward inclinations of passages 12 are further of advantage in that there is but little tendency for the mud jets coming from the passages to erode the walls of the hole being drilled. It has been found, on the contrary, that radial jets substantially perpendicular to the drilling unit, may cause fairly pronounced erosion of soft formations.

Tests made with this invention show a materially improved drilling performance as compared to the same unit with all the mud from the turbine directed out through the passages in the drill bit.

I claim:

1. In a turbine well drilling unit in which, a hydraulic turbine is driven by the drilling mud, a drill bit rotated by the turbine, and means to direct a part of the drilling mud into the bore hole through passages in the drill bit and the remainder of the mud into the bore hole without passing through the drill bit, said means imparting to the mud not passing through the drill bit an upward component of velocity and a tangential component of velocity to produce a downwardly directed force on said means and a torque in the same direction as the turbine torque.

2. In a turbine well drilling unit, in which a hydraulic turbine is driven by the drilling mud, a hollow shaft rotated by the turbine, means to direct into the hollow shaft the mud that has passed through the turbine, a drill bit, a connector with a central longitudinal passage interposed between the hollow shaft and drill bit, passages in the drill bit to direct into the bore hole drilling mud that reaches the bit through the hollow shaft and connector, and at least one passage extending upwardly from the hollow passageway on the inside of the connector to the outside thereof to divert a part of the drilling mud upwardly into the bore hole without passing through the drill bit.

3. In a turbine well drilling unit, in which a hydraulic turbine is driven by the drilling mud, a hollow shaft rotated by the turbine, means to direct into the hollow shaft the mud that has passed through the turbine, a drill bit, a connector with a central longitudinal passage interposed between the hollow shaft and drill bit, passages in the drill bit to direct into the bore hole drilling mud that reaches the bit through the hollow shaft and connector, and at least one passage extending from the hollow passageway in the connector to the outside thereof to divert a part of the drilling mud into the bore hole without passing through the drill bit, said passage extending non-radially from the connector to impart a tangential component of velocity to the mud passing through it and cause a torque to be exerted on the connector in the same direction as the turbine torque.

4. In a turbine well drilling unit, in which a hydraulic turbine is driven by the drilling mud, a hollow shaft rotated by the turbine, means to direct into the hollow shaft the mud that has passed through the turbine, a drill bit, a connector with a central longitudinal passage interposed between the hollow shaft and drill bit, passages in the drill bit to direct into the bore hole drilling mud that reaches the bit through the hollow shaft and connector, and at least one passage extending from the hollow passageway in the connector to the outside thereof to divert a part of the drilling mud into the bore hole without passing through the drill bit, said passage extending non-radially from the connector to impart a tangential component of velocity to the mud passing through it and cause a torque to be exerted on the connector in the same direction as the turbine torque, and sloping upwardly from the inside of the connector to the outside to impart an upward component of velocity to the mud leaving it and cause a downwardly directed force to be exerted on the connector.

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