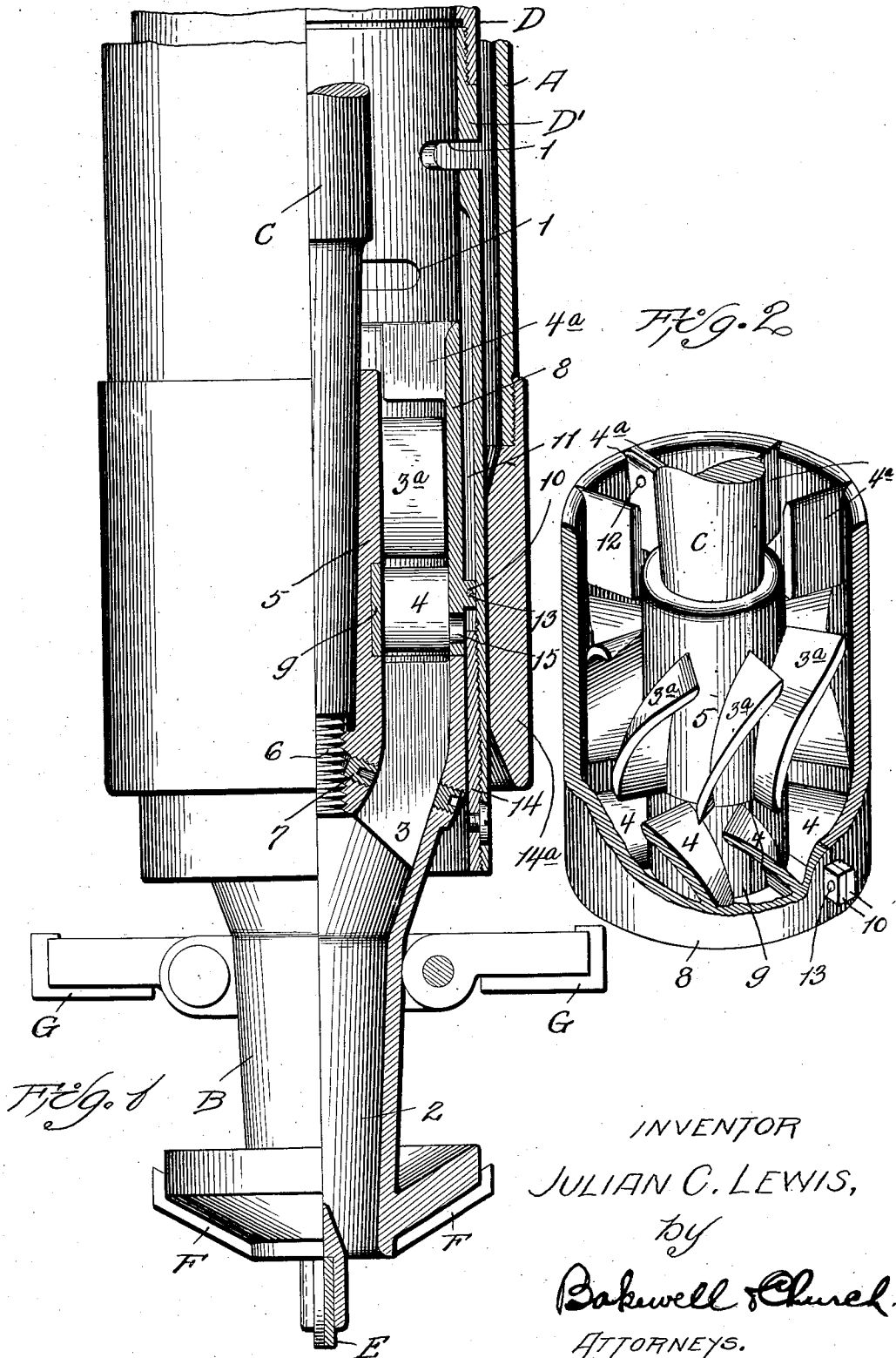


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ROTARY DRILL.

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To all whom it may concern:

Be it known that I, JULIAN C. LEWIS, a citizen of the United States, residing at St. Louis, Missouri, have invented a certain new and useful Improvement in Rotary Drills, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which appertains to make and use the same.

This invention relates to rotary drills such as are used in well drilling operations.

The main object of the invention is to provide a rotary drill which is so constructed that sufficient water will be supplied to the bottom of the hole when the drill is in operation to flush out the cuttings or disintegrated material and keep the cutting tool cool in case the drill is of the high speed type. Other objects and desirable features of my invention will be hereinafter pointed out.

To this end I have devised a rotary drill that is equipped with a pump or propeller arranged in close proximity to the bottom of the hole being drilled and so constructed that it causes a large volume of water to be forced downwardly through a water passageway in the head which is of sufficient cross sectional area to insure an adequate supply of water to the bottom of the hole. I have herein illustrated my invention embodied in a high speed drill of the type in which the head of the drill is driven by an electric motor, but I wish it to be understood that my invention is applicable to any type of rotary drill of the kind in which water is pumped down into the hole being drilled so as to flush out the cuttings or disintegrated material.

Figure 1 of the drawings is a side elevational view, partly in vertical section of a rotary drill constructed in accordance with my invention, and

Fig. 2 is a perspective view of a portion of the drill shown in Fig. 1.

Referring to the drawings which illustrate the preferred form of my invention, A designates the well casing, which remains stationary or at rest when the drill is in operation. B designates the head of the drill and C the operating shaft that rotates the drill head. In the drill herein shown the shaft C is driven or rotated by the armature shaft (not shown) of an electric motor whose housing D is clamped to the well

casing A in such a manner that said housing D will not turn or rotate when the electric motor is in operation. I have not illustrated the means that is used for clamping the housing of the electric motor to the well casing, as said means forms no part of my present invention.

When the drill is in operation water is admitted to the upper end of the well casing A and is forced downwardly through a passageway 2 in the head of the drill by a pump or propeller that is preferably built into the head, thereby causing the cuttings or the material that is disintegrated by the cutting devices on the head of the drill to be flushed out of the bottom of the hole and circulated upwardly around the outside of the well casing A in a well known manner. The housing D of the electric motor that rotates the head of the drill is connected to the housing D' of said pump, preferably by cooperating screw threads thereon, and said pump housing is provided with slots or orifices 1 through which the wash water is admitted to said pump housing, the blades of said pump being located below the orifices 1. I prefer to build the pump or propeller into the head of the drill and form the water passageway 2 in the head in such a manner that it serves as the discharge outlet of said pump or propeller. The water passageway 2 in the head is of great enough cross sectional area to insure sufficient water being supplied to the bottom of the hole to flush out the cuttings and to keep the cutting tools on the head of the drill cool, and in the form of my invention herein illustrated the water passageway 2 extends vertically through the lower end portion of the head B of the drill and terminates at the lower end of same, as shown in Fig. 1, thus causing a large volume of water to be discharged from the lower end of the head in close proximity to the cutters E and F.

The head B of the drill is provided with cutters E, F and G that can be of any preferred form, so long as they are of such design and arrangement that the centrifugal force generated in the flushing water by said cutters when the head of the drill rotates will exert an upward pumping action on the flushing water. In the drill herein shown the cutter E consists of a blade arranged transversely of the lower end of the head, the cutters F consist of radially-dis-

posed blades mounted on the exterior of the head and the cutters G consist of blades carried by arms that project laterally from the head. The cutters F and G surround the water passageway 2 in the head and are arranged in concentric relation with said passageway, thus causing the centrifugal force generated in the flushing water by said cutters to be greater at the periphery of the cutters than at the termination of the water passageway through which the flushing water escapes from the lower end of the head.

The pump or propeller previously referred to that forces the flushing water downwardly through the passageway 2 in the head comprises a set of revolving blades or vanes 3 and a set of stationary blades or vanes 4. If desired, said pump or propeller may be provided with a plurality of sets of revolving blades and a plurality of sets of stationary blades in instances where it is desired to produce considerable pressure and introduce a large volume of water into the bottom of the hole. The drill herein illustrated is constructed in this manner and is provided with a second set of revolving blades 3^a and a second set of stationary blades 4^a arranged above the blades 3 and 4, respectively. The head B of the drill herein drawn practically consists of a tubular member whose upper portion is of greater diameter than its lower portion, and a hub or sleeve 5 arranged inside of the upper portion of said tubular member and projecting upwardly above same, as shown in Fig. 1, said sleeve or hub 5 being securely connected to the tubular member that forms the outer surface of the head B and also being rigidly connected to the operating shaft C of the drill. In the drill herein shown the hub 5 is provided with an internally tapered bore that fits over a tapered portion at the lower end of the operating shaft C, said shaft C having an externally screw threaded portion 6 that is screwed into the lower end of the hub 5 and locked thereto by any suitable means, such, for example, as a set screw 7.

The blades or vanes 3 are arranged between the hub 5 and the tubular outer portion of the head B of the drill and are preferably integrally connected to said parts so as to serve as the connection between same. The stationary blades or vanes 4 are carried by a sleeve 8 that is arranged inside of the pump housing D', and a ring 9 that fits in an annular groove in the hub 5 of the drill head at a point above the upper ends of the revolving blades 3, said sleeve 8 being connected to the pump housing D' in such a manner that it will not revolve when the drill is in operation. The particular form or curvature of the blades 3 and 4 is immaterial, so far as my broad idea is concerned, so long as they are of such design that water

will be forced downwardly through the passageway 2 in the head, due to the cooperation of the revolving blades 3 and stationary blades 4. The upper revolving blades 3^a project radially from the hub 5, and the outer vertical edges of said blades are spaced away from the inner surface of the sleeve 8. The upper stationary blades 4^a project inwardly from said sleeve 8 and the inner vertical edges of said blades 4^a are spaced away from the outer surface of the hub 5. Any suitable means can be employed for preventing the sleeve from rotating relatively to the head B of the drill, the means herein illustrated for this purpose consisting of a laterally-projecting key or keys 10 on the outer surface of the sleeve 8 that enter a vertical groove or grooves 11 in the inner side of the pump housing D'. By connecting the sleeve 8 to the pump housing in this manner and providing the stationary blades 4 with a part 9 that fits in an annular groove in the hub 5 of the drill head, the sleeve 8 and the head B of the drill can move vertically slightly with relation to the pump housing D' without destroying the operative relationship between the revolving blades and the stationary blades of the drill. The sleeves 8 and 9, together with some of the blades 4 and 4^a are preferably split axially so as to facilitate assembling the parts of the drill, said sleeves being herein shown as composed of two sections connected together at their upper ends by fastening devices 12 that pass through cooperating blades 4^a, as shown in Fig. 2, and connected together at their lower ends by fastening devices 13 that pass through laterally-projecting lugs 10 on the sections of the sleeve 8 which constitute the keys 10 previously referred to that slide in the vertical grooves 11 in the pump housing D'. A removable bushing 14 that is arranged in the lower end of the pump housing D' and which has a close fit with the head B of the drill, as shown in Fig. 1, prevents the wash water and the cuttings from entering the pump housing. I also prefer to provide the well casing A with a shoe 14^a that has a close fit with the exterior of the pump housing D', and thus prevents the cuttings that are carried upwardly by the wash water from entering the space between the well casing and the pump housing. Orifices 15 are preferably formed in the lower end portion of the sleeve 8 adjacent to the grooves 11 in the pump housing so as to cause water to circulate upwardly through the grooves 11 and thus keep them clean when the drill is in operation.

When the head B of the drill rotates the pump or propeller formed by the cooperating revolving blades and stationary blades carried by the head of the drill and by the sleeve 8, respectively, will cause water to

be drawn inwardly through the openings 1 in the pump housing D' and forced downwardly through the water passageway 2 in the drill head, thus insuring an adequate supply of water at the bottom of the hole to flush out the cuttings or disintegrated material and to keep the cutting tools on the lower end of the drill head cool, as is necessary in a high speed drill. The flushing water, together with the cuttings, is forced upwardly from the bottom of the hole by the pumping action produced by the cutting devices on the head of the drill when said head rotates. Consequently, my improved drill may be said to have one pump, namely, the cooperating blades 3, 4, 3^a and 4^a, that draw water downwardly toward the bottom of the hole, and an independent pumping means, namely, the cutters on the head of the drill, that force the water upwardly from the bottom of the hole. The drill is strong enough to successfully withstand the strains to which it is subjected when in service; it is so designed that the drill head can move vertically slightly with relation to the pump casing D' without destroying the relationship between the revolving blades and stationary blades of the pump or propeller, and it is inexpensive to manufacture and easy to assemble and disassemble.

While I have herein illustrated the preferred form of my invention as consisting of a drill head of practically hollow form equipped with a pump or propeller built into the head and provided with revolving blades integrally connected to the outer portion of the head and to the center hub that connects the drill head to the operating shaft, I do not wish it to be understood that my invention is limited to a drill of the particular construction shown, but I prefer to construct the head of the drill in this manner on account of the fact that the lower portion of same constitutes the discharge opening or outlet of the water pump and is of sufficient cross sectional area to insure a large volume of water being delivered at the bottom of the hole, thus insuring successful operation of the drill.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. A rotary drill, comprising a head provided with a cutting means, and a water pump or propeller built into said head and comprising stationary blades and revolving blades that rotate with the head of the drill.

2. A rotary drill, comprising a revolving head provided with a water passageway, a cutting means on said head, and vanes or blades arranged in said passageway that cause water to be forced downwardly through said passageway when the drill is in operation.

3. A rotary drill, comprising a revolving head provided with a water passageway, a cutting means on said head, vanes or blades arranged in said passageway that cause water to be forced downwardly through said passageway when the drill is in operation, and stationary blades that cooperate with the blades in said passageway.

4. A rotary drill, comprising a hollow head through which water circulates when the drill is in operation, a cutting means on said head, and propeller vanes or blades in said head that induce a downward circulation of water through the head when the drill is in operation.

5. A rotary drill, comprising a head of substantially tubular form provided with a hub for connecting the drill head to an operating shaft, a cutting means on said head, and propeller blades or vanes arranged between the tubular portion of said drill head and said hub.

6. A drill, comprising a head of substantially hollow form, a cutting means on said head, means for connecting said head to an operating shaft, and propeller blades or vanes arranged in said head at a point above the lower end of the head for inducing a circulation of water downwardly through the head when the drill is in operation.

7. A rotary drill provided with a head comprising a hub portion, a tubular portion surrounding said hub portion and spaced away therefrom, a cutting means on said head, and vanes or blades arranged between said hub portion and tubular portion and integrally connected to same.

8. A rotary drill, comprising a head of substantially tubular form open at its upper and lower ends, a cutting means on said head, propeller blades or vanes inside of said head that revolve with the head, stationary blades or vanes arranged above said revolving blades, and means for holding said stationary blades at rest when the head of the drill rotates.

9. A rotary drill, comprising a head that is adapted to be rotated, and a water pump or propeller built into said head, said head having a water passageway in same of relatively great cross sectional area that constitutes the discharge outlet for said pump.

10. A rotary drill, comprising a rotatable head, and a water pump or propeller built into said head and comprising a plurality of sets of revolving blades that rotate with the head and a plurality of sets of stationary blades arranged in staggered relation with said revolving blades.

11. A rotary drill, comprising a rotatable head provided with propeller blades or vanes and a passageway through which water circulates downwardly when the drill is in operation, a part that is stationary with respect to said head when the drill is

in operation, blades or vanes carried by said stationary part, and a cutting means on said head.

12. A rotary drill, comprising a head provided with a plurality of sets of propeller blades or vanes, a sleeve surrounding a portion of the drill head, blades or vanes on said sleeve that cooperate with the blades on the drill head to form a water pump or propeller, means for holding said sleeve at rest when the drill head is in operation, and a cutting means on said head.

13. A rotary drill, comprising a rotatable head provided with a cutting means, a pump housing adapted to be held at rest in the casing of the hole being drilled, propeller blades combined with the head of the drill, and a sleeve held from rotation by said pump housing and provided with blades that cooperate with the blades on the drill head.

14. A rotary drill, comprising a rotatable head provided with a cutting means, a pump housing adapted to be held at rest in the casing of the hole being drilled, propeller blades combined with the head of the drill, a sleeve held from rotation by said pump housing and provided with blades that cooperate with the blades on the drill head, and means for permitting the drill head and said sleeve to move axially slightly relatively to said pump housing without destroying the operative relationship between said propeller blades.

15. A rotary drill, comprising a head provided with a cutting means, a pump housing adapted to be held at rest in the casing of the hole being drilled and provided with water inlets, and a pump or propeller arranged below said water inlets and having a discharge outlet of relatively great cross sectional area that terminates in the lower end of the drill head.

16. A rotary drill, comprising a rotatable head provided with a cutting means, a pump housing that is adapted to be held at rest in the casing of the hole being drilled, a sleeve in said housing, cooperating propeller blades on said sleeve and on the head of the drills, and means for preventing said sleeve from turning with relation to said pump housing when the drill is in operation.

17. A rotary drill, comprising a rotatable head provided with a cutting means, a pump housing that is adapted to be held at rest in the casing of the hole being drilled, a sleeve in said housing, cooperating propeller blades on said sleeve and on the head of the drill, and means for connecting said sleeve to said pump housing and to said drill head in such a manner that the sleeve will remain at rest when the drill is in operation but both the sleeve and the drill head can move axially slightly with relation to the pump housing.

18. A rotary drill, comprising a rotatable

head, provided with a cutting means, a pump housing that is adapted to be held at rest in the casing of the hole being drilled, a sleeve in said housing, cooperating propeller blades on said sleeve and on the head of the drill, a key on said sleeve that slides in a vertical groove in the pump housing, and means for causing water to circulate through said groove so as to keep it clean when the drill is in operation.

19. A rotary drill, comprising a rotatable head provided with a cutting means and with propeller blades, a sleeve surrounding said head and provided with cooperating propeller blades, a pump housing surrounding said sleeve and adapted to be held at rest in the casing of the hole being drilled, means for preventing said sleeve from turning with relation to said pump housing when the drill is in operation, and a removable bushing in the lower end of said pump housing that surrounds the drill head.

20. A rotary drill, comprising a rotatable drill head of substantially tubular form whose upper portion is of greater diameter than its lower portion, a cutting means on said drill head, a hub arranged inside of the upper portion of the drill head for connecting the drill head to an operating shaft, propeller blades or vanes integrally connected to said hub and to the portion of the drill head that surrounds same, a sleeve surrounding said hub and provided with propeller blades that cooperate with the blades on the head, and means for preventing said sleeve from rotating when the drill is in operation.

21. A rotary drill, comprising a rotatable drill head of substantially tubular form whose upper portion is of greater diameter than its lower portion, a hub arranged inside of the upper portion of the drill head for connecting the drill head to an operating shaft, propeller blades or vanes integrally connected to said hub and to the portion of the drill head that surrounds same, a sleeve surrounding said hub and provided with propeller blades that cooperate with the blades on the head, means for preventing said sleeve from rotating when the drill is in operation, and a ring-shaped part secured to the blades on said sleeve and arranged in an annular groove in the hub of the drill head.

22. A rotary drill, comprising a head provided with a tubular portion that forms a passageway for water that is forced downwardly into the hole being drilled, propeller blades or vanes arranged in the upper portion of said passageway and combined with the head in such a manner that they revolve with the head, stationary propeller blades arranged above the revolving blades on the head, and a housing surrounding the upper portion of the head that holds said

stationary blades at rest and which is provided with water inlets through which water is drawn into the passageway in the drill head when the drill is in operation.

5 23. A rotary drill, comprising a head, a water pump or propeller built into said head for drawing water downwardly into the bottom of the hole being drilled, and a cutting means on said head which tends to pump 10 the water upwardly away from the bottom of the hole.

15 24. A rotary drill, comprising a hollow head through which water circulates when the drill is in operation, cooperating stationary and rotating propeller blades in said head that induce a downward circulation of

water through the head when the drill is in operation, and a cutting means on the exterior of the head which tends to pump the water upwardly away from the bottom of 20 the hole.

25. A rotary drill, comprising a hollow head through which water circulates when the drill is in operation, rotating stationary propeller vanes or blades in said head that 25 induce a downward circulation of water through the head when the drill is in operation, and cutter blades on said head which cooperate with said propeller vanes by 30 pumping the water up on the outside of said head.

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