Jan. 27, 1953 J. E. ORTLOFF 2,626,780

DOUBLE-ACTING DRILL BIT

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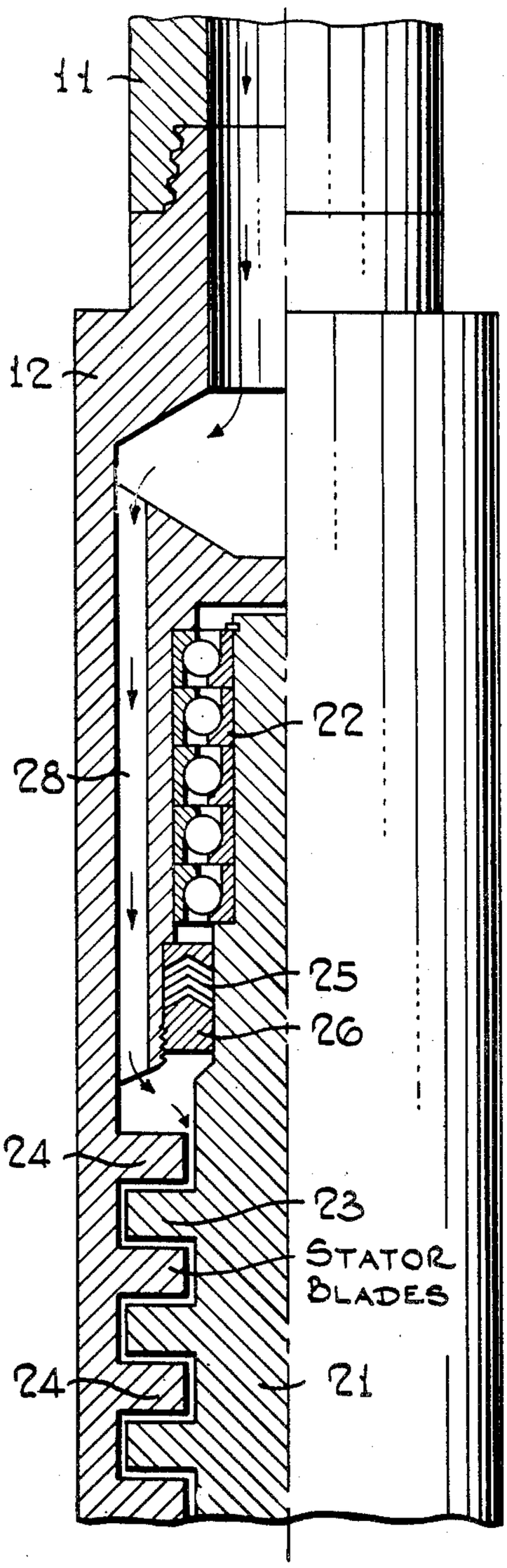


FIG.-1

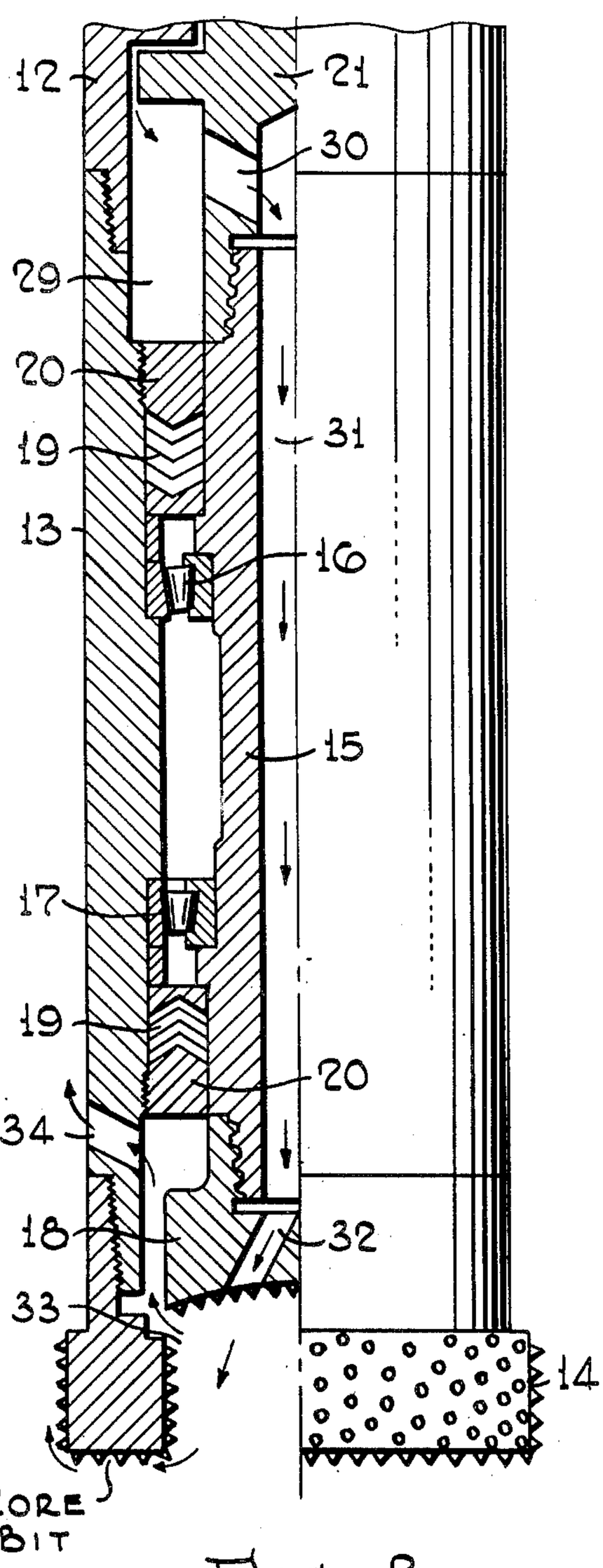


FIG.-2

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## DOUBLE-ACTING DRILL BIT

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4 Claims. (Cl. 255—4)

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The present invention concerns an improved type of drill bit for drilling bore holes in the earth. More particularly it relates to a double acting drill bit wherein the central portion of the bit is driven at a higher speed than the outer portion.

In present day practice the drilling of a large proportion of the bore holes in the earth for the production of crude petroleum oil from underlying oil bearing strata is accomplished by what is known as rotary drilling. In this method drill pipe is run into the full length of the bore hole and is provided with a bit at its lower end. The drill bit is rotated to accomplish the drilling by a combination of scraping, grinding and percussion forces which break up the rock ahead of the drill. A drilling fluid is circulated down through the drill pipe and back through the annulus between the drill pipe and the walls of the hole to remove cuttings and to seal the hole.

It has been observed that certain types of hard sand and chert are of such a nature that ordinary rock bits tend to wear out in a relatively short time if such formations are encountered. It has also been found that diamond coring bits will drill through such formations much more efficiently than the usual rock bits. However, the use of diamond core bits for drilling has the disadvantage that the drill pipe must be pulled out of the hole at regular intervals in order to remove the core. Although cores of up to 90 feet in length can be taken at one time a great reduction in cost could be effected if the cored section could be drilled or ground up as the drilling progresses inasmuch as a diamond core bit can cut in excess of 500 feet of core before requiring replacement. Hence it has been proposed to employ full hole diamond bits rather than coring bits. These have usually not been entirely satisfactory because of the inherent fact that the linear velocity of the outer periphery of the bit is much greater than at the center of the bit. As a result the outer edge or rim of the bit cuts its way through before the center does and imposes all of the bit load on the center diamonds, which causes them to fail prematurely. One solution that has been employed to overcome this difficulty has been to make a bit that cuts a core, which is then ground up by secondary cutters or grinders. An alternative solution to the problem has been to provide a bit having a plurality of co-planar cutters, one of the cutters being of sufficient diameter to overlie the geometrical center of the hole being drilled. Such drill bits have left much to be desired however in view of the necessity for independent drives such as systems of planetary gearing for rotating the secondary cutters or grinders in the first solution mentioned or the plurality of cutters in the second solution mentioned, as well as gripping means to engage the wall of the bore hole to provide the necessary torque for the secondary drive.

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It is one object of the present invention to provide an abrasive type bit that will drill a full hole more efficiently than can be done with conventional full hole diamond bits.

It is another object of the invention to provide a full hole abrasive drill bit having a minimum of moving parts while nevertheless ensuring at least as great a cutting speed at the center of the hole as at the edges of the hole.

In accordance with this invention a drill bit assembly is provided which comprises a tubular case that is attached to the lower end of a drill pipe, the case carrying on its lower end a coring head such as a conventional diamond core head, or similar coring means employing abrasive particles, behind which is rotatably mounted secondary cutting means on a central shaft which is driven by a multi-stage hydraulic turbine built into the assembly. The rotor plates of the turbine are on the central shaft driving the secondary cutting means and the stator blades are in the outer case which drives the coring head.

The nature of the invention will be more readily understood from the ensuing description when read in conjunction with the accompanying drawing in which Fig. 1 is an elevational view, partly in section, of the upper portion of one embodiment of the invention and Fig. 2 is a lower continuation of Fig. 1.

Referring now to the drawing it will be seen that an outer tubular case or shell 12 is provided which is made in two separable sections 12 and 13. The upper section 12 is readily screwed onto the lower portion of drill pipe 11. A more or less conventional diamond core head 14 is screwed onto the bottom of the lower section 13. Concentrically disposed within the lower tubular section 13 is a tubular shaft 15 which defines with case 13 an annular chamber into which are fitted combination thrust and radial bearings 16 and 17, which rotatably support shaft 15. Attached to the lower end of shaft 15 but above coring head 14 is a secondary cutting means 18 which preferably is an essentially circular bit impregnated with diamonds or other abrasive particles or alternatively may be a small cone or roller type rock bit. Bearings 16 and 17 are protected from contamination from drilling mud by cup type

packing seals 19 which are held in place by bronze follower rings 20.

Disposed within the central portion of the upper half 12 of the outer case is a central shaft 21 provided with a plurality of rotor blades 23. Shaft 21 is rotatably supported by thrust bearings 22 which are protected from mud contamination by seal 25 held in place by follower ring 26. Cooperatively placed with respect to rotor blades 23 and attached to the interior of upper case section 12 are a plurality of stator blades 24 so that the assembly constitutes a multi-stage turbine which will rotate shaft 15 when drilling mud is conducted downward through the drill pipe, through mud passages 28, past the turbine blades, through chamber 29, mud ports 30, central passageway 31 and mud ports 32. Preferably central bit 18 is placed above coring head 14 a sufficient distance to provide a passageway 33 so that some of the mud may pass out through mud ports 34 and back up the borehole. The direction of mud flow is indicated by the arrows.

The hydraulic turbine comprising shaft 21 and the rotor and stator blades 23 and 24 is preferably so designed that the central shaft will be turned in the same direction as the outer case and drill pipe; thus the central bit 18 will turn at least as fast or faster than the coring head 14, making it possible to grind up the core made by coring head 14 as fast as the core is fed into the bit.

One of the important features of this invention is that rotation of the inner bit is achieved without the use of wall gripping devices to resist the reactive torque produced when the inner bit is rotated, this torque being resisted by the drill stem. Also, no planetary gearing is used to increase the speed of the central shaft. Another important feature of the invention is that mud and cuttings are effectively sealed off from the bearings and other vital parts of the bit and mud flow through the bit as well as return flow is not restricted.

It is not intended that this invention be interpreted as limited to the specific embodiments described, as modifications thereof are possible without departing from the spirit of the invention whose scope is limited only by the following claims.



What is claimed is:

1. A drill bit assembly comprising an elongated tubular case attachable to the lower end of a drill pipe, a coring head held by the lower end of said case, said coring head having a central opening for receiving a core, a plurality of abrasive particles held by said coring head, a tubular shaft disposed within said case lengthwise thereof and defining with the interior wall of said case an annular chamber, bearings in said annular chamber rotatably supporting said tubular shaft, sealing means in said annular chamber isolating said bearings from fluid in said chamber, secondary cutting means fixed to the bottom of said tubular shaft above said coring head adapted to grind up a core entering said central opening, turbine drive means in said case attached to said shaft and adapted to rotate the same and provided with at least one entering port communicating with said drill pipe and with at least one exit port terminating within said tubular shaft.

2. Drill bit assembly according to claim 1 wherein said secondary cutting means comprises an essentially circular bit carrying abrasive particles.

3. Drill bit assembly according to claim 1 wherein at least one fluid port is provided in the wall of said case, terminating in said annular chamber below said sealing means.

4. Drill bit assembly according to claim 1 wherein said turbine drive means comprises a plurality of vertically spaced rotor blades placed in said annular chamber and fixed to said tubular shaft and a plurality of stator blades cooperatively placed in said annular chamber with respect to said rotor blades and attached to the inner wall of said case.

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