

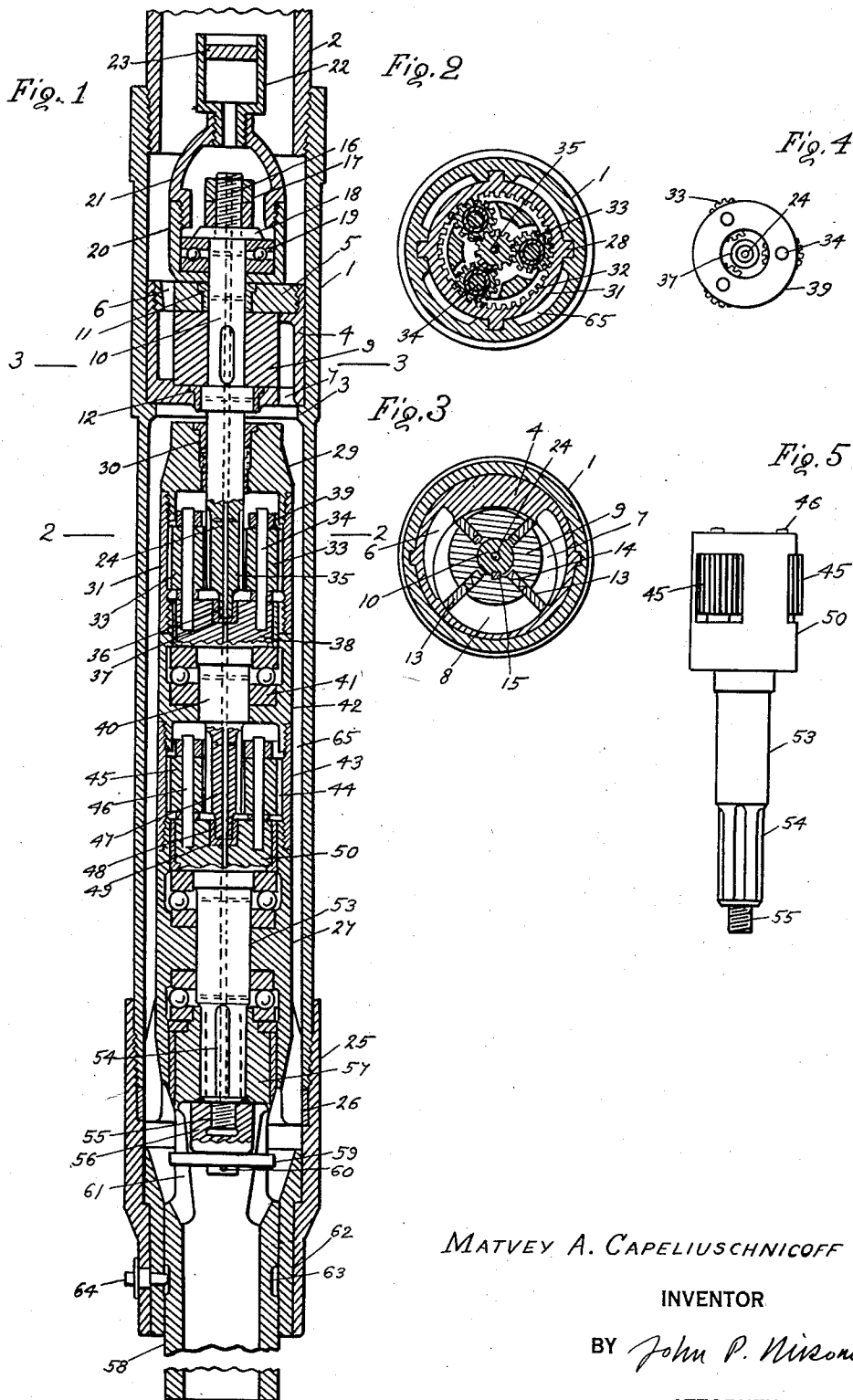
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WELL DRILLING TOOL

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WELL-DRILLING TOOL

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My invention relates to well drilling tools and has a particular reference to rotary tools for drilling deep holes such as oil wells.

The object of my invention is to provide a drilling device adapted to be placed at the bottom of a well and further adapted to be operated by a hydraulic motor forming a part of this device. The motor is operated by an ordinary liquid mud or similar fluid which is pumped under high pressure to the bottom of the well into a hollow bit through a pipe and returns to the top of the well carrying with it the loose material removed by the drilling tool or operating bit.

With my arrangement the tool housing remains stationary and does not rotate, being only gradually lowered as the drilling operation is progressing. The pipes through which the mud is pumped also remain stationary.

This invention represents an improvement over my earlier invention for which I obtained United States Patent No. 1,681,094 of Aug. 14, 1928. The improvement consists in the use of a positive rotary hydraulic motor based on a volume displacement principle, containing reciprocating parts. Another improvement consists in the use of two or more reduction units between the motor and the drilling tool or bit, the reduction units being connected in tandem. I also employ an improved construction for the planetary gear housing so as to eliminate twisting of the satellite shafts, and an improved method of holding the drilling bit in the hollow shank.

My invention is more fully described in the accompanying specification and drawing in which—

Fig. 1 is a sectional elevation of my apparatus, Fig. 2 is a section on the line 2—2 (Fig. 1), Fig. 3 is a section on the line 2—2 (Fig. 1), Fig. 4 is a top view of the satellite housing, and Fig. 5 is an elevation of a lower satellite housing with the shaft extension.

My drilling apparatus consists of a tubular housing 1 provided with threads on top for a pipe 2 through which the operating fluid is pumped into the drilling tool through my apparatus. The housing has a shoulder 3 inside on which rests an outer shell 4 of a hydraulic motor. A cover 5 is screwed into the upper

portion of the shell 4 and is provided with a port 6 through which the operating fluid is admitted into the motor. The bottom of the shell 4 has an exhaust port 7 on the side opposite the intake port 6. The shell 4 has a cylindrical aperture 8 inside arranged eccentrically in relation to the housing 1. A rotary block 9 is placed inside of the aperture 8 mounted on a shaft 10 rotatively supported in bearings 11 and 12. The block 9 has transversely arranged slots for sliding gates 13. Springs 14 tend to press the gates to the inner surface of the shell 4 in the aperture 8. The block 9 is fastened on the shaft 10 with a key 15. The upper end of the shaft 10 has a threaded portion 16 with nuts 17 and a thrust washer 18 resting on a thrust ball bearing 19 placed in a cup 20. This cup is closed on top with a cap 21 fitted with a lubricator 22, consisting of an oil cup with a piston 23. It is filled with a heavy lubricating oil or grease, and the pressure of the operating fluid, acting on the piston, forces the lubricant into channels 24 in the shaft 10 and in the other shafts below.

The lower end of the housing 1 is screwed into a sleeve 25 clamping also lugs 26 of a gear reduction housing 27. This housing is provided with ribs 28 fitting in corresponding slots in the housing 1 which prevent the housing 27 from rotating under the action of the motor shaft.

The upper block 29 has a bearing 30 for the middle portion of the shaft 10 and is screwed into a shell 31 provided on the inside with gear teeth 32 forming an internal gear in mesh with pinions or satellites 33. These satellites are rotatably mounted on pins 34 and are also in mesh with a pinion 35 cut integrally on the end of the shaft 10. The lower end 36 of the shaft 10 is rotatively supported in a bearing 37 in a bottom plate 38 of a housing 39 for the satellites 33. This housing is hollow inside for the pinion 35 and has slots on the sides for the satellites 33. Their pins are supported in the bottom and top plates of the housing 39.

This housing 39 is provided with a shaft extension 40 and is supported on a thrust ball bearing 41 in a sleeve 42 screwed on top

into the shell 31, and at the bottom into a shell 43 which has gear teeth 44 inside forming an internal gear in mesh with satellites 45. The latter are rotatively mounted on pins 46 and are in mesh with a pinion 47 cut on the end of the shaft 40 the lower tip 48 of which is supported in a bearing 49 in the bottom plate of a satellite cage 50. The satellites 45 are rotatively mounted on pins 46 fastened in the cage 50. The cage 50 is supported on a thrust ball bearing 52 in the housing 27. It has a shaft extension 53 the lower end of which has splines 54 and a threaded end 55 for a nut 56 which holds in place on the splined end the upper portion 57 of a hollow bit holder 58. A retaining washer 59 is placed on the square end of the nut 56 and is held in place with a cotter pin 60. The washer has an oblong shape with its longer ends fitting in the side slots 61 of the bit holder 58. A bearing bushing 62 is placed between the sleeve 25 and the bit holder 58.

A circular slot 63 is provided on the bit holder 58 into which is fitted the end of a retaining pin 64 fastened in the wall of the sleeve 25 and passing through the bushing 62. This arrangement prevents the bit holder from falling out in case the nut 56 becomes unscrewed or the threaded end of the shaft breaks.

The operation of my device is as follows:

A suitable hollow drilling bit (not shown) of any ordinary construction is placed in the bit holder 58, and the pipe 2 is screwed into the top of the housing 1. The device is then placed in a well (or on the surface for beginning the operation) and a mud solution (or any other suitable liquid ordinarily used for rotary drilling) is pumped under pressure into the pipe 2. This solution or operating fluid passes from the pipe 2 through the port 6 into the chamber 8 of the hydraulic motor pressing against the vane 13. The vane under pressure will move in a direction of increased volume, or counter-clockwise in Fig. 3.

On the other side of the motor the vane 13 will force the fluid through the exhaust port 7 into the channels 65 formed between the inside walls of the housing 1 and the outside walls of the inner housing formed of tubular members 31, 42, 43 and 27. The fluid then passes through the slots 61 into the hollow bit holder 58 and into the bit (not shown). It picks up the loosened dirt from the bit and carries it away and up from the well along the sides of the housing 1 and pipe 2.

With this arrangement the shell 1 does not rotate itself and the pipe 2 also remains stationary, being gradually lowered into the well as the drilling work progresses. Such absence of rotation on the part of the pipes 2 reduces the amount of power required for

the drilling operation, eliminating the heavy friction of the pipes against the sides of the well caused by the spiral twisting of these pipes at greater depths. An additional saving in the power expenditure is obtained through the elimination of transmission and gearing for rotating the pipe 2.

Such absence of rotation of the pipes 2 greatly reduces the deviation of the drilled hole at great depths. Such deviation represents a serious drawback of ordinary rotary systems and is caused by the spiral twisting of the pipes so that the tool itself takes an angular position and works sideways, especially in inclined strata.

The rotary hydraulic motor with reciprocating vanes has a positive action and can produce a constant torque even at slow speeds proportional to the operating surface of these vanes. Its work is proportional to the volumetric displacement as in ordinary reciprocating engines.

I claim as my invention:

1. In a well drilling tool, the combination with a tubular housing, of a hydraulic motor supported in said housing, a shaft extending centrally from said motor, a pinion on the end of said shaft, satellites in mesh with said pinion, a tubular cage supporting said satellites around said pinion, a shaft extending centrally from said cage, a pinion on the end of said cage shaft, a second set of satellites in mesh with said cage shaft pinion, a second tubular cage for said satellites, a second cage shaft extending from said second cage, means to removably attach a drilling bit to said second cage shaft, said hydraulic motor being adapted to impart rotation to said bit through said pinions and satellites, and stationary internal gears in mesh with said satellites.

2. In a well drilling tool, the combination with a tubular housing, of a hydraulic motor in said housing adapted to be operated by a liquid under pressure, a shaft extending from said motor, a pinion on the end of said shaft, satellites in mesh with said pinion, a tubular cage with apertures in its walls for said satellites, said satellites being rotatively supported in said cage, a shaft integrally formed with said cage, a pinion on the end of said cage shaft, a second set of satellites in mesh with said cage pinion, a second cage for said satellites, a shaft extension on said second cage, stationary internal gears in mesh with said satellites, means to removably attach a drilling bit to said second cage shaft, a thrust bearing on the upper end of said motor shaft, a housing enclosing said bearing, a cylindrical container for a lubricant on said housing, and a piston in said container adapted to force said lubricant to said bearing and to said shaft, all of said shafts being provided with internal ducts for admitting said lubricant to their journals.

3. In a well drilling tool, the combination with a tubular housing, of a hydraulic motor in said housing, a shaft extending from said motor, a pinion on the end of said shaft, a planetary transmission engaged by said pinion, a shaft extending from said planetary transmission, a tubular bit rotatively supported in said housing, a yoke on the tail end of said bit removably fitted on the end of said transmission shaft, means to prevent the relative rotation of said transmission shaft and said bit, a nut on the end of said transmission shaft adapted to rest against the inner surface of said yoke, and means to prevent the rotation of said nut.

In testimony whereof I affix my signature.
MATVEY A. CAPELIUSCHNICOFF.