

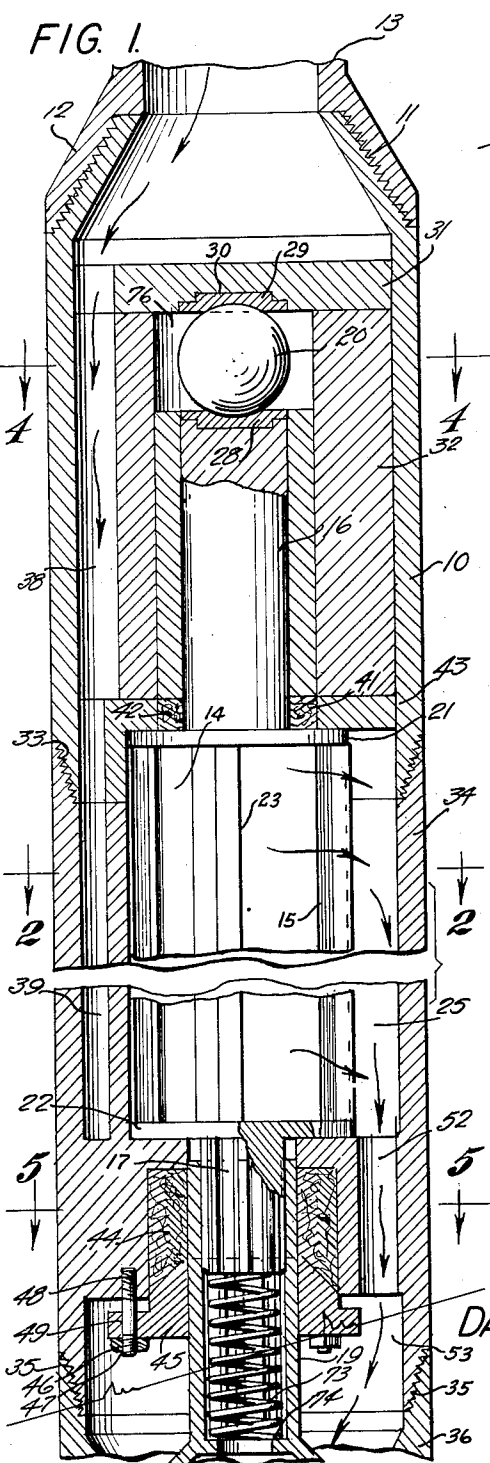
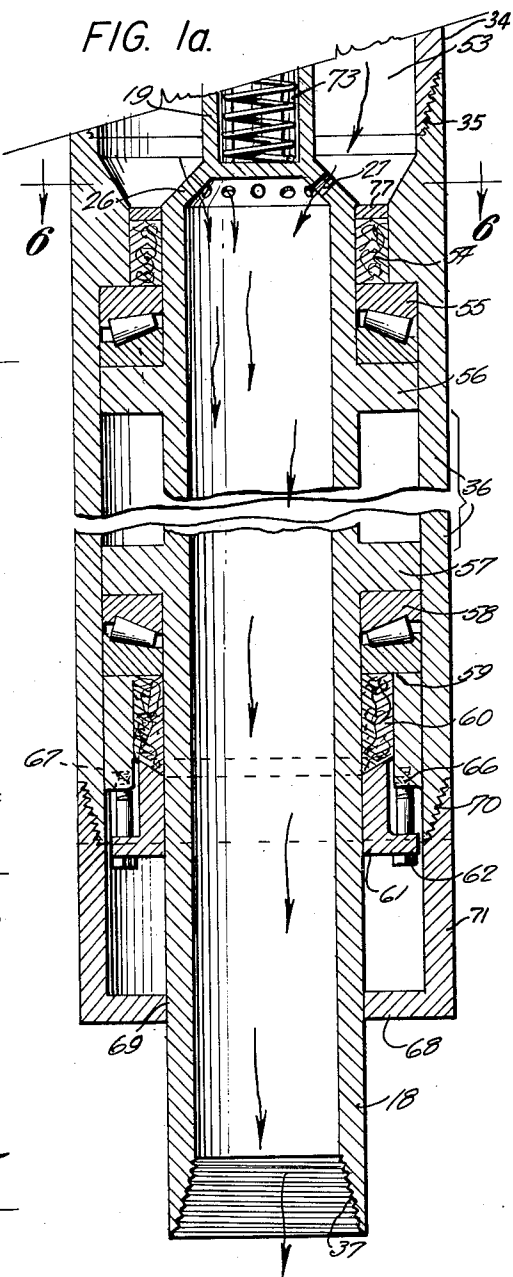
Dec. 12, 1961

D. A. HOAGLAND
FLUID ACTUATED DRILL

3,012,618

Filed Sept. 25, 1958

2 Sheets-Sheet 1



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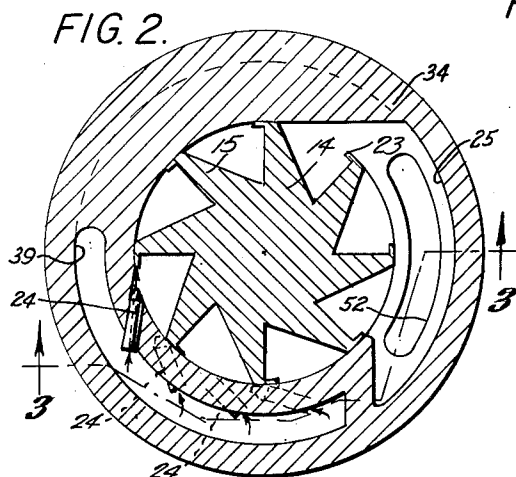
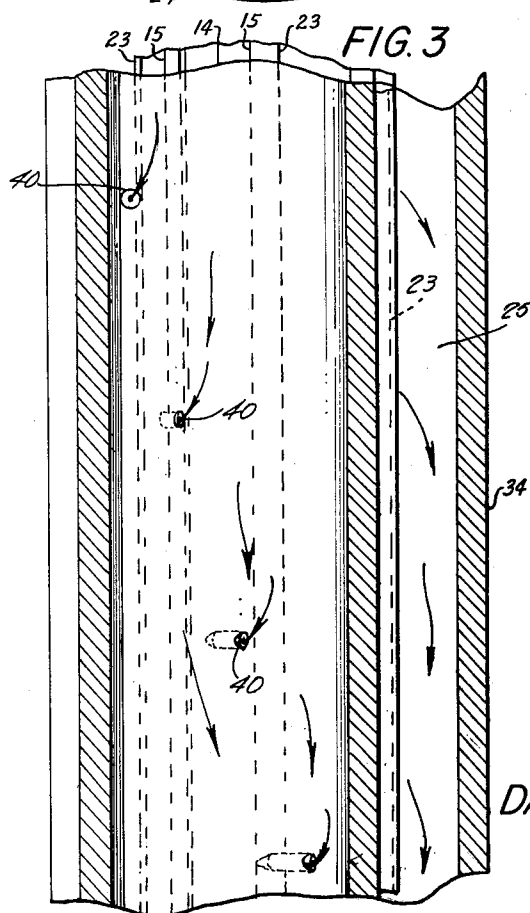
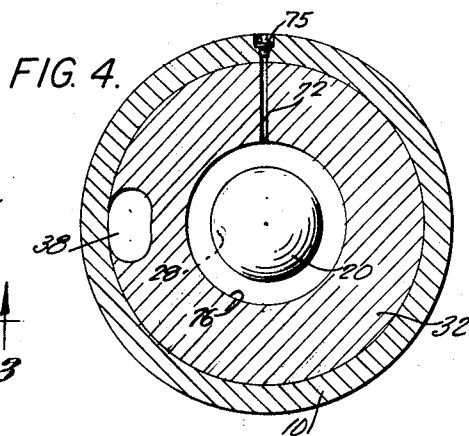
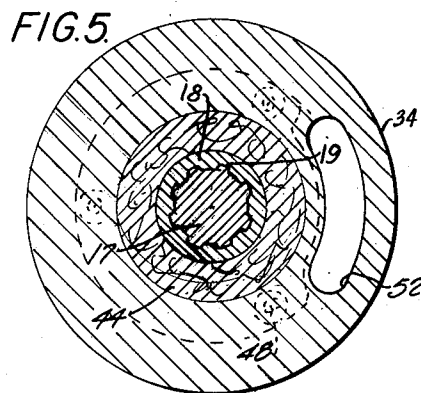
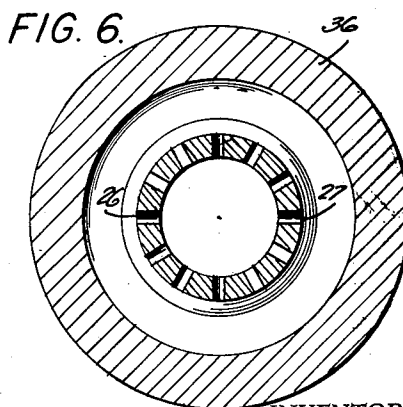
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FLUID ACTUATED DRILL

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Filed Sept. 25, 1958, Ser. No. 763,216
1 Claim. (Cl. 175—107)

This invention relates to well drilling, particularly for gas, oil, and other products, and in particular a jet actuated drill bit, or the like, carried by a well string or pipe and actuated by fluid pumped into the string or pipe and discharged through jets against vanes of an impeller to which the drill bit is connected, whereby the drill bit is rotated at high speed with the string or drill pipe and drill collars rotating at comparatively low speed.

The purpose of this invention is to provide means for increasing speed of a drill head in well drilling without increasing the speed of a well string, pipe, and associated parts.

In the operation of a rotary drilling rig the long string or drill pipe with a bit on the lower end is used and the full length of the pipe is turned by a rotary table on the rig which turns the bit. The bit and pipe are turned at a speed of from 75 to 300 revolutions per minute. It is impossible to increase the speed because the high speed results in fatigue in the pipe, breaking the pipe or string. Wear of the parts is in proportion to the speed at which the drill is operated and attempts to operate drills at high speed have resulted in excessive wear of the string, collars, and drill pipe. The cost of replacing drill pipe is very high and there are from one to twenty drill collars on the lower end of the drill pipe which provide weight on the drill. These collars wear rapidly at high speed and the collars, which are from twenty to forty feet long weigh from one to four tons. For conventional operation a large mud pump is used to circulate fluid down the inside of the string or drill pipe with the fluid passing downwardly through the bottom of the bit and returning upwardly around the drill string and pipe carrying cuttings of the bit. This fluid is permitted to settle at the surface and after settling the fluid is reused. With this thought in mind this invention contemplates a jet impelled drill bit wherein fluid pumped through the string or well pipe is discharged through jets against blades of an impeller whereby with the impeller connected to the drill bit the bit is rotated independent of the well string and drill pipe. By this means the drill string, pipe, and collars may be turned as slow as ten revolutions per minute with the drill bit operating at high speed.

The object of this invention is, therefore, to provide means for rotating a drill bit independent of a supporting string or well pipe.

Another object of the invention is to provide means for rotating a drill bit with fluid pumped through the well string or pipe into a drilling rig whereby the drill bit may be rotated at high speed with the supporting elements turning at relatively low speed.

Another important object of the invention is to provide an impeller for operating a drill bit at the lower end of a well string whereby the drill bit may be rotated at high speed with the string and collars turning at low speed.

A further object of the invention is to provide an impeller that is splined to the shaft connected to the drill bit so that the shaft and drill bit assembly will not have to be removed to replace the impeller.

A further object of the invention is to provide a well drilling assembly having a drill bit on the lower end of a well string in which the bit is rotated independently of the string by fluid under pressure passing through the

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string in which the device is of a simple and economical construction.

With these and other objects and advantages in view the invention embodies a cylindrical casing carried on the lower end of a well string, an impeller having longitudinally disposed blades thereon rotatably mounted in the casing, jets provided in the casing and positioned to discharge fluid pumped into the well string against the blades of the impeller, a drill bit, means operatively connecting the impeller to the drill bit, and suitable bearings and packing glands for preventing leakage of the fluid pumped into the jets or nozzles through the well string.

Other features and advantages of the invention will appear from the following description taken in connection with the drawings, wherein:

FIGURE 1 is a vertical section through the upper portion of a well drilling assembly showing an impeller having a shaft with a splined lower end and a ball thrust bearing on the upper end and, illustrating in particular, the path of fluid under pressure passing from a well string through nozzles against blades of an impeller for operating the drill bit, parts of the device being broken away.

FIGURE 1a is a view showing a continuation of the drilling assembly shown in FIGURE 1 illustrating, in particular, a tubular shaft for carrying a drill bit or the like extended from the impeller shown in FIGURE 1 and showing bearings and packing glands of the lower part of the assembly.

FIGURE 2 is a cross section through the assembly shown in FIGURES 1 and 1a being taken on line 2—2 of FIGURE 1 and illustrating, in particular, the relative positions of the jets or nozzles and blades of an impeller rotatably mounted in the casing.

FIGURE 3 is a vertical section showing a portion of the cylindrical casing being taken on line 3—3 of FIGURE 2 and showing, in particular, an arrangement of nozzles or jets for discharging fluid against blades of the impeller.

FIGURE 4 is a cross section taken on line 4—4 of FIGURE 1 showing a ball thrust bearing in the upper end of the assembly.

FIGURE 5 is a sectional plan taken on line 5—5 of FIGURE 1 showing the splines of the shaft extended from the lower end of the impeller and also showing a fluid passage through one side of the housing.

FIGURE 6 is a sectional plan taken on line 6—6 of FIGURE 1a showing openings providing passage for fluid under pressure through the tubular shaft connected by the splines to the impeller to a drill bit or head.

Referring now to the drawings wherein like reference characters denote corresponding parts the improved well drilling assembly of this invention includes a cylindrical casing 10, the upper end of which is connected by threads 11 to a flange 12 on the lower end of a well string 13, an impeller 14 having blades 15 on the peripheral surface and having a shaft 16 extended from the upper end and a splined shaft 17 extended from the lower end, a tubular shaft 18 having an internally splined hub 19 on the upper end and positioned to receive the splined shaft 17 of the impeller, and a ball 20 at the upper end of the shaft 16.

As illustrated in FIGURE 1 a collar 21 is provided at the upper end of the blades of the impeller and a similar collar 22 is provided at the lower end. The blades 15, which are formed with lips 23 on outer edges extend between the collars 21 and 22, and with the impeller positioned as illustrated in FIGURE 2 fluid under pressure pumped downwardly through the well string is discharged through the nozzles 24 against the blades of the impeller causing the impeller to rotate.

After being impinged upon the blades of the impeller the fluid escapes into an opening or passage 25 that ex-

tends downwardly to an inclined section 26 of the upper end of the tubular shaft 18 wherein the fluid passes through openings 27, passing downwardly through the shaft 18 and through the drill bit or head washing away the cuttings and carrying the cuttings upwardly around the drill assembly to the upper end of the well.

The upper end of the shaft 16 is provided with a bearing insert 28 and a similar insert 29 is provided in a recess 30 in a disc 31 at the upper end of a section 32, the disc 31 and section 32 having a press fit in the casing 10. The ball 20 is positioned intermediate of the inserts 28 and 29 in contactual relation therewith thus providing a thrust bearing at the upper end of the shaft 16. The lower end of the casing 10 is provided with threads 33 by which the casing is connected to a cylindrical section 34 positioned below the casing 10 and the lower end of the section 34 is connected by threads 35 to the lower cylindrical housing 36 that is positioned below the sections 34 in vertical alinement therewith and with the casing 10. Another end of the tubular shaft 18 is provided with internal threads 37 by which the shaft and impeller are connected to a drill bit or the like.

The upper portion of the cylindrical housing 10 is provided with a longitudinally disposed passage 38 that connects the interior of the well string 13 to a chamber 39 which is in communication with the nozzles or jets 24. The jets or nozzles are positioned to discharge through openings 40 through the wall of the inner portion of the cylindrical section 34 whereby fluid under pressure is discharged against the blades 15.

A packing gland is provided at the upper end of the impeller and, as shown in FIGURE 1 the packing or sealing ring 41 is positioned in an opening 42 in an inwardly extended collar 43 press fit into the outer casing or housing 10. A packing gland 44 is positioned around the hub 19 of the tubular shaft 18 and the packing gland is provided with a ring 45 that is adjustably held by nuts 46 on studs 47 that extend through openings 49 in the ring 45 and are threaded into openings 48 in the section 34.

The lower end of the section 34 is provided with a passage 52 which provides communicating means between the open chamber 25 and an area 53 which is in communication with the interior of the tubular shaft 18 through the openings 27.

The upper end of the cylindrical housing 36 is provided with a packing gland 54 that is retained in position by a packing unit 77 and a thrust bearing 55 which is positioned on a flange 56 extended from the tubular shaft 18. The tubular shaft 18 is also provided with a flange 57 and a thrust bearing 58 is positioned below the flange 57 and abuts the upper end of an annular ring or shoulder 59 that is press fit into the lower end of the housing 36. A packing gland 60 is also provided in the housing 36 within the ring 59 and around the tubular shaft 18 and the packing gland is provided with a take-up or adjusting ring 61 that is actuated by bolts 62 which extend to the lower edge of the ring 59. As shown in FIGURE 1a, the inner ends of the bolts 62 are provided with threads 66 that are threaded into openings 67 in the ring 59 in the cylindrical housing 36. The lower end of the cylin-

dricl housing 36 is provided with threads 70 whereby a cup-shaped cover or guide portion 71 is removably connected thereto and the lower end of the cover 71 is provided with an inwardly extended flange 68 and the tubular shaft 18 is slidably mounted in an opening 69 of the flange.

It will be understood that drill bits or other implements or devices may be secured to the lower end of the tubular shaft 18.

The area 76 above the upper end of the impeller shaft 16, and in which the ball 20 is positioned, is provided with a grease groove 72 that has a grease fitting 75 in the outer open end thereof as shown in FIGURE 4.

The splined hub 19 of the tubular shaft 18 is provided with a spring 73, the lower end of which is positioned on a shoulder 74 and the upper end of which bears against the lower end of the splined shaft 17 for urging the impeller outwardly of the splined hub 19 when the impeller is being removed and to compensate for any wear between the collars 21 and 22 and their abutting flanges.

It will be understood that modifications, within the scope of the appended claim, may be made in the design and arrangement of the parts without departing from the spirit of the invention.

What is claimed is:

In a drill bit, for well drilling, the combination which comprises an elongated cylindrical casing, a cylindrical section removably connected to said casing, a cylindrical housing removably connected to said section, a cup-shaped guide portion removably connected to said housing, an impeller having longitudinally disposed blades thereon rotatably mounted in the cylindrical section, nozzles mounted in one side of the cylindrical section and positioned to discharge fluid under pressure from the well string against the blades of the impeller, resilient means for urging the impeller upwardly to compensate for wear between the impeller and the cylindrical casing, a thrust bearing in the casing and positioned between the impeller and casing, a splined shaft on the lower end of said impeller, a tubular shaft having a splined hub on the upper end thereof for removably receiving the splined shaft on said impeller for operatively connecting the shaft to the impeller, said shaft being extended below the lower end of the cylindrical casing, drill bit connecting means on the lower end of the tubular shaft, a packing gland at the upper end of said impeller, a packing gland at the upper end of the cylindrical housing, said tubular shaft having parallel flanges thereon, thrust bearings engaging said flanges, an adjustable packing gland within said cylindrical housing and engaging said tubular shaft, and collars on the upper and lower ends of said impeller.

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