Nov. 12, 1940. D. McCLELLAND 2,221,242

DRILL

Filed Jan. 28, 1939

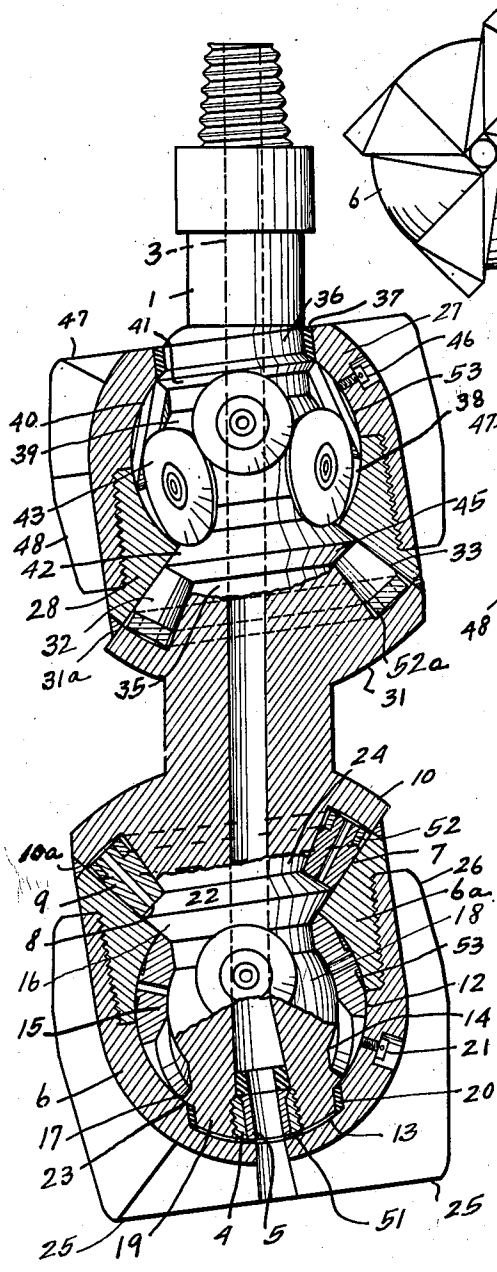


Fig. 1.

Fig. 3.

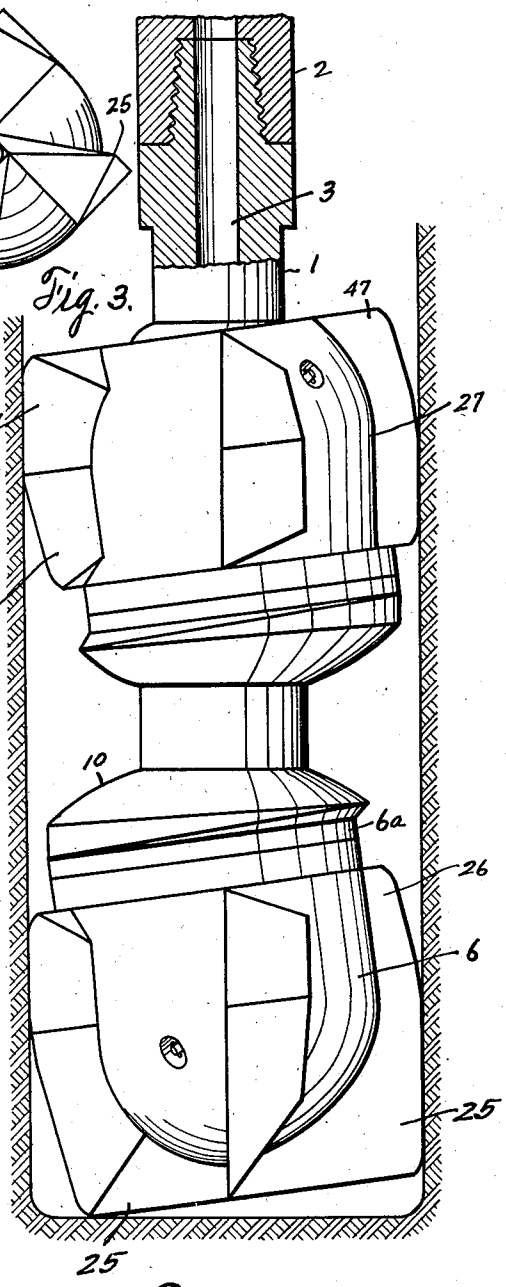


Fig. 2.

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Patented Nov. 12, 1940

2,221,242

UNITED STATES PATENT OFFICE

2,221,242

DRILL

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Application January 28, 1939, Serial No. 253,317

2 Claims. (Cl. 255—71)

This invention relates to a drill.

An object of the invention is to provide a drill of the character described specially designed for drilling straight holes and is of such construction that the formation at the bottom and side walls of the bore will be rapidly disintegrated, flushing fluid being forced through the drill stem and drill to cool the mechanism and carry away the drill cuttings.

Another object of the invention is to provide a mechanism for stabilizing the tool to maintain the same in vertical position to insure a cylindrical or approximately straight bore and to counteract the shock to the drill pipe caused by the oscillation at the cutter head.

It is another object of the invention to provide a drill wherein the self-aligning antifriction bearings, and stabilizer are at all times concentric with respect to each other and equi-distant from the cam shaft center or focus point of the bearings and free to move in harmony with the frusto-conical cam faces, whereon they are mounted, said bearings being mounted to move at oblique angles to the axis of the cam shaft which is attached to and driven by the drill stem.

The drill head and stabilizer are so mounted that when subjected to an axial thrust, while the drill is being operated, they have a combined rotary oscillatory and sliding movement around a common focus point, while the radial cutters are compelled to travel in a gyratory path around said focus point.

It is another object of the invention to provide a drill of the character described having a driven cam shaft which may be rotated at very high speed independent of the cutter head and stabilizer, which swivel on self-aligning bearings provided on the cam shaft.

The tool is of such construction that should the cutter head have a tendency to drift from a vertical path on account of the inclination of the formation or for any other reason the cam shaft will remain vertical in center of bore hole forming a stabilizer which will be automatically forced against the opposite side of the bore and act as a fulcrum thereby causing the drifted tool to take the line of least resistance, which is a cylindrical path and the direction of the bore will thereby be restored to vertical, or approximately a straight course.

It is another object of the invention to provide a tool of the character described consisting of a drill head and stabilizer including radially extended helical cutter blades so mounted on a rotatable cam shaft that as the shaft is rotated and subjected to an axial thrust the helical blades will present a single deep penetrating point of contact against the bottom of the bore and against the side wall to rapidly disintegrate the formation with chisel-like effect, as the cutter head and stabilizer gyrate, roll and oscillate due to the rotation of said shaft. Said blades will also act as impellers to force the drilling fluid up the bore hole.

With the above and other objects in view the invention has particular relation to certain novel features of construction, operation and arrangement of parts, an example of which is given in this specification and illustrated in the accompanying drawing, wherein:

Figure 1 shows a vertical, sectional view of the drill.

Figure 2 shows a side elevation, and

Figure 3 shows a bottom end view of the cutter head.

Referring now more particularly to the drawing wherein like numerals of reference designate the same parts in each of the figures, the numeral 1 designates the cam shaft as a whole which is attached to the lower end of the conventional drill stem 2. The drill stem is tubular and the cam shaft has an axial water course 3 extending downwardly from the upper end thereof and emerging at the lower end thereof through which drilling fluid is pumped to the cutters at the bottom of the bore and is returned up, partly helped by the impeller cutters, to the ground surface on the outside of the drill stem, carrying with it in suspension the drill cuttings.

Threaded into the lower end of the cam shaft 1 there is a plug 4 containing a nozzle 5 of hardened material. This nozzle may be readily replaced, when cut out by the gritty fluid by removing the plug 4. The numeral 6 designates the drill head whose lower end is approximately spherical in form and screwed into whose upper end is a gland 6a which terminates in an annular plane face 7, which diverges upwardly and rides against the antifriction convex-concave cone bearings 9 mounted to rotate in an annular split cage 52 which distributes the thrust. The bearings 9 have the axial lubricant channels 8. Above the head on the shaft 1 there is the hood 10 which hoods over, encloses and retains said bearings in place. It will be noted that the inner surface of the head and gland 6a presents the contour of a spherical segment 12 and is pro-

vided at its lower end with a recess 13 which has a concaved lower end.

The lower portion of the cam shaft enclosed by the head 6 has a circumferential groove 14 thereabout forming a raceway for the convex-concave frusto-conical shaped bearings 15 and also providing the upper and lower annular bearing faces 16, 17. Between each bearing and the gland 6a is a washer 53. As will be noted from an inspection of Figure 1 there are two series of roller bearings 15, the upper series rolling on the face 16 and the lower series rolling on the face 17. Between the faces 16 and 17 the surface 18 of the cam shaft is curved and is concentric with the inner face 12 of the head 6. The roller bearings 15 are concavo-convex and rotate in washers 53 against said outer face 12 and the bearings of one series are staggered with respect to those of the other series, as shown. At its extreme lower end the cam shaft has a cylindrical extension 19 extending into the recess 13 and of somewhat smaller transverse diameter than that of said recess to allow sufficient clearance to permit the insertion of two resilient hydraulic packers 20 and 51 around said extension.

In assembling the head 6 on the cam shaft, the roller bearings 9 and the gland 6a, may be first assembled and the bearings 15 assembled and the head inserted thereover and screwed onto the gland 6a. The head is provided with a grease gun connection 21 of conventional construction through which a lubricant may be supplied to the bearings 15.

The external surfaces of the bearings 15 are substantially flush with the external surfaces of the annular spherical curved upper and lower faces 12 and 18 so that said flush, external faces present, as a whole, a spherical segment.

The inner ends of the bearings 9 fit against the annular face 22.

Adjacent the underside of the hood 10 the cam shaft is provided with a frusto-conical cam 24, against which the conical bearings 9 roll and rotate in their cage 52. The axis of the cam 24, is inclined to the vertical axis of the shaft 1, the degree of inclination being usually about 7½° from the vertical. Therefore, as the cam shaft rotates the cutter head will oscillate in a 15° arc and will gyrate and roll forwardly. The speed of rotation of the cutter head will be much slower up to $\frac{1}{24}$ that of the cam shaft but the gyrations will be mutual. As the cutter head so rotates and gyrates it is obvious that it will also oscillate back and forth and the lower margins of the cutter blades 25 will rock back and forth in substantially vertical planes thus gradually disintegrating the formation at the bottom of the bore with chisel-like effect as the cutter head gyrates, rolls and oscillates forwardly. While one cutter blade is operating against a point on the bottom of the bore at one side of the axis the side margin of the opposite cutter blade 25 will be operating against a point on the side wall of the bore adjacent the bottom thereof as clearly shown in Figure 2. The blades 25 are extended upwardly along the sides of the head at an angle of 7½° to axis of body 6 forming the side cutter blades 26, 26 which also, in a similar fashion, operate against the side walls of the bore. While one cutter blade 25 is chiseling against one side wall of the bore, the opposite cutter blade 26 will ream against the opposing side of the bore as shown in Figure 2.

Spaced above the cutter head 6 there is a stabilizer head 27 arranged reversely with respect to the head 6 but of the same general external contour. The external surface of the head 27 is approximately that of spherical segment, and screwed into the lower end of said head there is a gland 28 having an inside downwardly flared face 33 against which the bearings 32 ride. These bearings are engaged by an upwardly directed hood 31 formed integrally with the shaft 1. The bearings 32 are mounted to rotate in the annular split cage 52a. The cam shaft 1 is formed with a cam 35 whose axis is substantially parallel with the corresponding axis of the complementary cam 24 into which the cam shaft is formed and the bearings 32 ride against the cam 35. The upper end of the head 27 is formed with a bearing to receive the circular wrist 36 which is formed integrally with the cam shaft 1 but whose axis is common with the axis of the cam 35 but inclined with respect to the axis of the cam shaft. A sealing ring 37 formed of suitable packing material is located between the bearing of the head 27 around the wrist 36, and outside seals 10a and 31a and located between the glands 6, 6a and the respective hoods 10, 31.

Within the head 27 the cam shaft is formed with an annular groove 38. The bottom of this groove presents the curved face 39 of a spherical segment which is concentric with the inside correspondingly curved face 40 of the head 27. The groove 38 has the upper and lower annular, outwardly flared faces 41, 42 against which the upper and lower series of the convex-concave frusto-conical shaped bearings 43 ride. These bearings are concavo-convex, being shaped similar to the bearings 15 and those of the upper series are arranged staggered to the lower series as shown in Figure 1.

The outer surfaces of the bearings 43 are substantially flush with the outer surface of the upper and lower, annular, spherical external faces 40 and 39 of the cam shaft with the washers 53 between them and the inside of the head, thus presenting a bearing surface against the interior of the head 27 which is of the approximate contour of a spherical segment.

In assembling the stabilizer, the rollers 32 and the gland 28 are first assembled. The bearings 43 may then be assembled about the cam shaft and the head 24 fitted thereover and screwed into place with the packing 37 assembled therewith. The head 27 has a grease gun connection 46 of conventional construction through which a lubricant may be supplied to the bearings 43.

It is to be noted that the annular bearing faces 16, 17, 22 and 23 have a common center with the cam 24 and the bearing faces 41, 42, 44 and 45 have a common center with the cam 35.

As the cam shaft rotates it is therefore obvious that the stabilizer head 27 will gyrate in company with it and the upper and lower cutter blades 47, 48, which extend out radially from said head will be subjected to axial thrusts as the head oscillates about the axis of the cam shaft and the cutting edges of said blades will operate against the wall of the bore and will thus ream out and bring the bore to full gauge.

The stabilizer will also act, against the side of the bore, as a fulcrum, and will tend to hold the cutter head to a true vertical course.

The drawing and description disclose what is now considered to be a preferred form of the invention by way of illustration only, while the broad principle of the invention will be defined by the appended claims.

What I claim is:

1. A drill comprising a shaft having an axial channel therethrough and formed with a truncated spherical surface, an annular cam on the shaft adjacent said spherical surface with its axis positioned obliquely to the axis of the shaft, a head mounted on the shaft around said spherical surface with one end thereof adjacent said cam, antifriction bearings around the cam and operative against said end of the head, means for forming a fluid tight joint between the other end of the head and the shaft, the inner surface of the head being spherically shaped concentrically around the spherical surface of the shaft and spaced therefrom, concavo-convex conical bearings, with their annular margins in abutting relationship with each other, filling the space between said curved surfaces to thereby retain the head on the shaft due the spherical shape of said surface.

2. A drill comprising a shaft, a downwardly tapered frusto-conical shaped cam on the shaft and a truncated spherical surface formed on the shaft below the cam, a tubular head positioned on the shaft, a gland connected to the top of the head whose top margin is adjacent said cam, antifriction bearings around the cam and operative against said margin of the gland, a hood on this shaft confining said antifriction bearings, the inner surface of the head and gland being spherically shaped concentrically around the spherical surface of the shaft and spaced therefrom, concavo-convex conical bearings with their annular margins in abutting relationship with each other filling the space between said curved surface to thereby retain the head on the shaft due to the spherical shape of said surface, means for forming a seal between the cam and gland, also between the head and shaft to thereby form a closed chamber bounded by said spherical surface and containing the bearings, means for introducing by pressure a lubricant into said chamber.

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