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SELF-CLEANING FLUID CIRCULATING DRILL BIT

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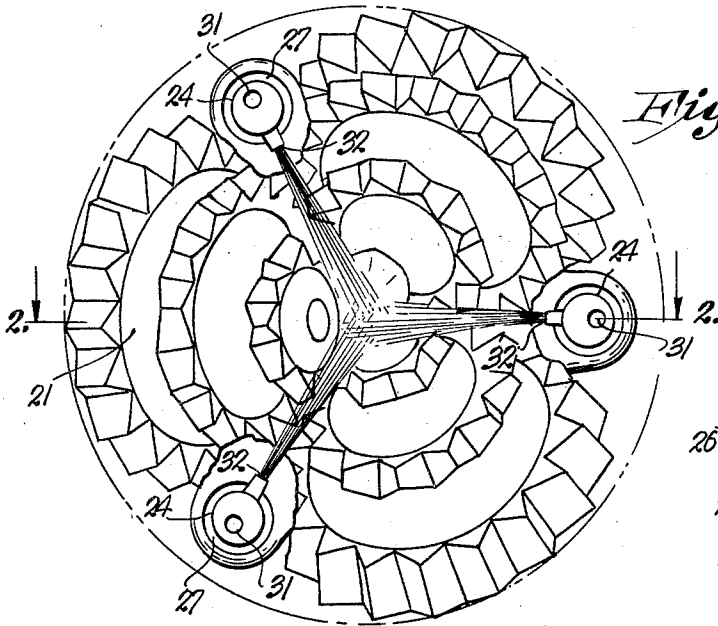


Fig. 1.

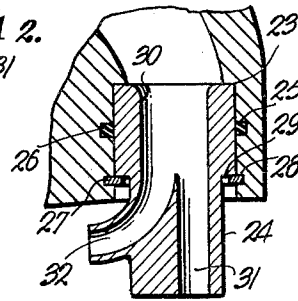


Fig. 3.

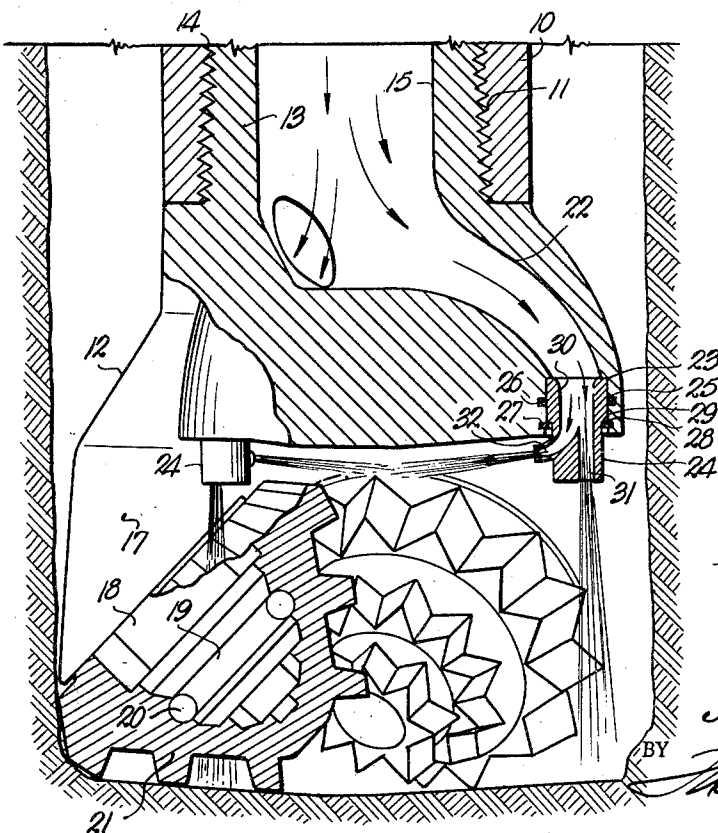


Fig. 2.

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SELF-CLEANING FLUID CIRCULATING
DRILL BIT

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This invention relates to drill bits for earth boring and refers more particularly to a fluid circulating drill bit for such purpose which is self-cleaning whereby to maintain the cutting elements of the drill bit free for operation at all times.

It is well known in the art to provide well drilling apparatus employing various types of rotary cutters, roller cutters, cone bit cutters, etc. It is additionally known in the art to circulate fluids through a drill bit in the vicinity of the cutting elements whereby to maintain same clear and free of cuttings, mud, fragments of rock, and the like. Typical patents along these lines include Childs et al. 1,656,471, Hild 1,749,344, Brownlee 2,049,047, Zublin 2,151,545, Windslow 2,200,482, Howell 2,637,529, Peter 2,749,092, Kucera 2,754,091, Williams, Jr. 2,776,115, Miller et al. 2,900,171 and Baur et al. 2,949,281.

Viewing the above-listed array of patents as typical of the drill bit art which includes fluid flow relative to the cutters, various typical paths of flow may be noted. Thus, a direct vertical blast or flow centrally of the cutter elements is well known. Blasts or flows directed at the teeth or edges of the cutting elements are well known. Flows directed to one side to sweep cutting elements past or away from the cutting elements are also well known in the art. The provision of a plurality of flows is known, whether directed toward or away from the cutting elements. Tortuous and elaborate channelways through the drill bit heads are often provided. Nozzles of many sorts to direct flow are also known.

Despite all of this development, the problem of clogging of drill bit cutting elements and "balling up" of the bit in particular certain sticky formation, such as shale, has not been solved by the art. As conventional drill bits spin, the rollers or cutting elements grind the rock thereunder, crushing and cutting and pulverizing it. If the material sticks in the teeth of the rolling cutters, the drilling and cutting action is slowed down or stopped entirely until the cutters are somehow again cleared of debris. A drill bit which "balls up" slows down the drill and, particularly when one cutting element is involved or there is asymmetric balling up, the hole may curve off at an angle and the desired straightness of drilling lost. Whenever a bit necessarily must be pulled from the hole in an oil field before it has lost the sharpness of its cutters, major time and effort are lost. This procedure is called pulling the bit green. Additionally, most types of cutters employed, particularly the cone bit cutters, have a certain tendency to tamp the formation under the cutters, rather than move the same out from under whereby to increase the tendency to bind or ball up the bit. In many drill bits, cuttings tend to pack between the cones or cutting elements and the bottom of the body of the bit. Fluid directed to the bottom of the cones and/or the formation per se is not sufficient to do the job. It is drilling practice to never go back into the hole with the same bit, once the bit has been pulled because it is not making way. If the bit is balled up, with the bit still sharp, losses are taken on the inefficient use of the bits.

An object of the invention is to provide a drill bit assembly with fluid flow jets operative to keep the drill bit from "balling up" in sticky formations and shale type formations whereby to provide a bit which drills faster and longer and additionally makes a straighter hole.

Another object of the invention is to provide a drill bit assembly with spray jets thereon which sprays fluid

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under the drilling elements or drill cones at the bottom of the body of the bit whereby to keep same clean of cuttings at all times, thereby making it impossible for the bit to ball up as such is usually the case in sticky formations.

Another object of the invention is to provide a drill bit assembly with cleaning fluid flow passages therein which obtains the optimum life out of the bit without balling up of the cutters thereof.

Another object of the invention is to provide a spray jet drill bit assembly which so directs the fluid flow under the body of the bit as to cause a marked turbulence centrally thereunder whereby to provide a continuously agitating fluid zone thereunder whereby to continuously keep the formation cuttings, debris, etc. from packing under the cones of the bit and "balling up" the bit operation.

Another object of the invention is to provide a spray jet drilling bit assembly which simultaneously sprays fluid from a plurality of orifices at a jet velocity both between the cones and under the body of the bit centrally of the cones whereby to keep the bit cones clean at all times.

Another object of the invention is to provide such a spray jet drilling bit wherein the cleaning fluid is sprayed under the cones of the bit and therebetween at all times when the pump is working and drilling is in progress.

Another object of the invention is to provide a spray jet drilling bit wherein side and central jets are provided from a plurality of locations on the bit, the side jet hitting the bottom of the hole and keeping it clean, the central jets continually spraying the top of the cones and the bottom of the shank or the body of the bit whereby to keep same clean and from packing up with whatever formation material they are cutting.

Another object of the invention is to provide a spray jet drilling bit of maximum cleaning effectiveness which is simple in construction, relatively cheap to manufacture, and wherein all the parts thereof are readily accessible for repair or replacement.

Another object of the invention is to provide a spray jet drill bit which provides a plurality of precisely directed jet sprays, yet which has a minimum of tortuous passages through the drill bit head whereby to minimize frictional losses in fluid flow.

Another object of the invention is to provide a spray jet drilling bit which simultaneously washes the tops and sides of the cones and the formation at the same time.

Other and further objects of the invention will appear in the course of the following description thereof.

In the drawings, which form a part of the instant specification and are to be read in conjunction therewith, embodiments of the invention are shown and, in the various views, like numerals are employed to indicate like parts.

FIG. 1 is a bottom view of the subject spray jet drilling bit showing the central spray blast.

FIG. 2 is a side partly sectional and partly cut away view of the drill bit of FIG. 1 in the borehole of a well.

FIG. 3 is an enlarged detail of one of the dual purpose spray jets usable in the instant construction.

Referring to the drawings, at 10 is shown the lower end of a drill pipe which is internally threaded as at 11. The numeral 12 generally designates the housing or body of the subject drilling bit which has an upward extension 13 which is externally threaded as at 14 and has a central passageway 15 extending down the central portion thereof. The lower end of the passageway 15 is sealed by the top 16 of the bit body. A plurality of outwardly angled mounting flanges or legs 17 on the under side thereof are fixed to or integral with the bit body 12 and mount cutter or roller shafts 18 thereon. Typically, shafts 18 have at least one roller bearing race 19 carrying

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roller bearing 20 thereon. Conventional cone-type cutters or rollers 21 are rotatably mounted thereon.

All of the above-described construction is well known in the art and conventional, as will be seen from reference to the listed patents at the beginning of the specification.

Turning to the improvement which is the subject matter of the instant application, a plurality of flow or feed passages 22 extend outwardly from the lower end of passageway 15 to a position closely adjacent the periphery of the bit body and positioned between the mounting flanges 17 and the cutters 22 thereon. While a bit having three rollers or cutters is shown, it should be understood that any number of mounting flanges 17 and cutters 21 thereon may be employed, it being desirable to have as many passages 22, as there are spaces between cutters. Here there are three cutters and three spray jet passages.

Nozzle receiving recesses 23 are formed at the end of flow passages 22 whereby to receive spray jet nozzles 24. An O-ring recess 25 to receive O-ring 26 is preferably provided intermediate the length of recess 23. Retaining ring 27 is received in recess 28 whereby to retain the spray nozzle 24 in the recess 23 by engaging of the shoulder 29 thereof. A single passageway 30 in the upper portion of the jet nozzle 24 divides into a pair of passageways 31 and 32 below the lower surface of the bit body portion 16. It should be noted that the portion of the spray jet nozzle above the shelf 29 may be of other shape than circular in cross section whereby to permit the precise fixing of the spray jet nozzle in the recess 23, which should be congruent with such shape so that the alignment of the desired flow path will not be disturbed. A square cross section in the recess 23 and upper portion of the spray jet would be typical. Alternatively, the jet nozzle may be keyed into the recess 23 to avoid rotation thereof.

The pathway of nozzle 31 is substantially vertically downward, preferably, with any desired vertical deflection therefrom as required by the particular hole being drilled, either outward against the formation wall or inward toward the cutters. A deflection of greater than 50° in FIG. 2 in either direction or through a conical deflection of 30° from the axis of the vertical in FIG. 2 would be extremely unusual. The flow path of the jets 32 is a slight acute angle from the horizontal and radially centrally whereby to pass between the cutters and meet in a central impact area centrally of said cutters. This causes a zone of continuous high turbulence above and centrally of the cutters.

In operation, when the drill bit is being rotated by rotation of drill pipe 10 whereby to roll the cutters 21 on the bottom of the hole, the fluid pump circulates at the surface, continually driving fluid through passageway 16 and out uniformly into flow passages 22. This flow in each passage is broken into two jets as shown whereby to achieve the detailed objects listed. Flow passages 31 and 32 may neck down or have any desired orifice shape.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth together with other advantages which are obvious and which are inherent to the structure.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim:

1. A drilling bit comprising a body, said body having an upper portion attached to hollow bit suspending means for rotation thereby, said upper portion having a primary flow passage therein connecting at its upper end with the

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hollow portion of said bit suspending means, said body also having a central portion thereof integral with said upper portion and extending therebelow, a plurality of cutters mounted below said body central portion on means connected to said central portion on a lower part thereof and arranged in a circumferentially spaced array thereon, said body central portion having a plurality of secondary flow passages therein, each said secondary flow passage in said body central portion passing from an upper connection thereof with said primary flow passage out to a position adjacent the periphery of the lower part of said body central portion between a pair of adjacent cutters and opening above same from said body central portion, means associated with said lower part of said body periphery between each pair of adjacent cutters having a pair of continuously open tertiary flow passages therein, each said tertiary flow passage communicating at its upper end with the lower end of a secondary flow passage and the other end of one of each pair of tertiary flow passages directed and opening substantially vertically downwardly for continuous fluid flow therethrough between said pair of cutters and the other end of the other one of said tertiary flow passages opening and directed substantially horizontally inwardly between said pair of cutters for continuous fluid flow therebetween, whereby the paths of the latter fluid flows intersect below the body central portion lower part.

2. A drill bit as in claim 1 wherein each pair of the tertiary flow passages are located in a single removable nozzle, which nozzle is connected with an upper end thereof in flow receiving position at the lower end of one of said secondary flow passages.

3. Apparatus as in claim 1 wherein the cutters and secondary flow passages are each three in number and spaced equidistant from one another and from the central vertical axis of the bit body.

4. Apparatus as in claim 1 wherein the secondary flow passages extend both outwardly and downwardly away from the main input flow passage in said body central portion in a smooth curve of lessening cross-sectional area.

5. Apparatus as in claim 1 wherein the direction of flow of fluid from the inwardly directed tertiary flow passages is substantially radial with respect to the vertical and rotational axis of said body as mounted on said suspending means, whereby the said flows will cross one another at a substantially common central position below the body central portion lower part.

6. Apparatus as in claim 5 wherein the said body central portion lower part between said inwardly directed tertiary flow passages is substantially horizontal when the said body portion has its rotational axis on said suspending means substantially vertical.

7. Apparatus as in claim 1 wherein the direction of extension of flows from the horizontally and inwardly directed tertiary flow passages extend substantially radially with respect to the underside or central portion lower part and at a horizontal level substantially the same whereby to meet in a turbulent zone substantially under and centrally of said central portion lower part and at substantially the same level, the said central portion lower part dished downwardly centrally thereof at substantially the angle of downward extension, if any, of said inwardly directed flows, said central portion lower part at least flat.

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