Aug. 7, 1962 R. W. BECK 3,048,231

DRAG BIT PROVIDED WITH CONSTANT JET NOZZLE STANDOFF

Filed Feb. 11, 1959

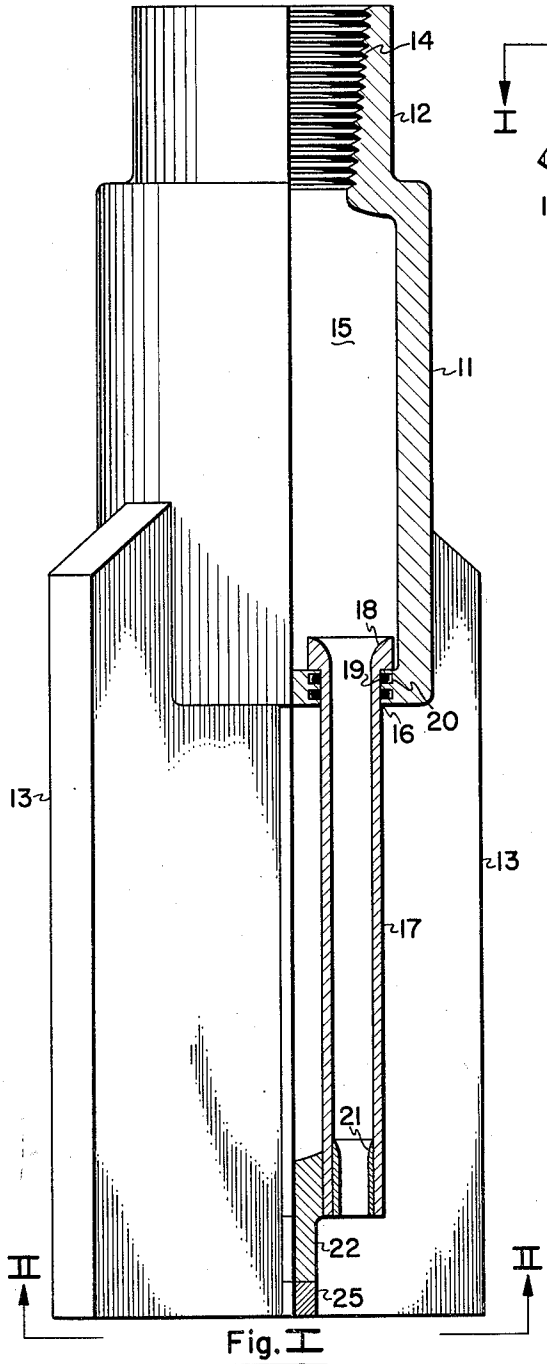

Fig. I

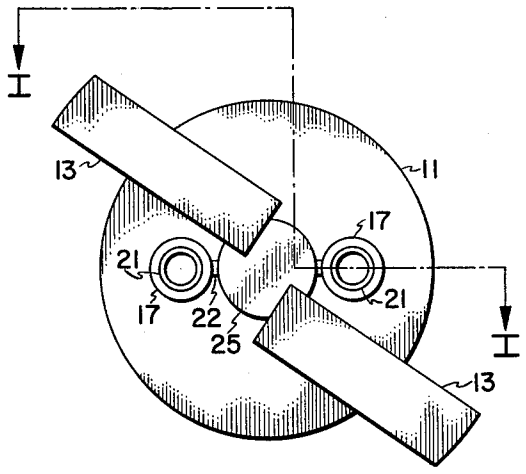

Fig. II

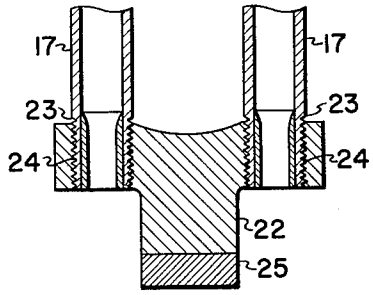

Fig. III

Robert W. Beck Inventor

By W. C. Hilman Attorney

United States Patent Office 3,048,231 Patented Aug. 7, 1962

3,048,231
DRAG BIT PROVIDED WITH CONSTANT JET NOZZLE STANDOFF

Robert W. Beck, Caracas, Venezuela, assignor to Jersey Production Research Company, a corporation of Delaware

Filed Feb. 11, 1959, Ser. No. 792,613
3 Claims. (Cl. 175—393)

The present invention relates to apparatus for drilling boreholes in the earth and more particularly relates to an improved drag bit fitted with self-adjusting jet nozzles which are maintained at an essentially constant level above the lower end of the bit during rotary drilling operations.

A majority of the oil and gas wells and similar boreholes produced in recent years have been drilled by rotary drilling methods. Briefly, such methods involve the use of a bit which is rotated against the formation being drilled into in order to produce a combination of scraping, grinding and percussion forces which break down the formation beneath the bit relatively rapidly. Rotation of the bit is accomplished by clamping the upper end of a string of drill pipe extending from the bit to the earth's surface in a rotary table and rotating the entire drill string. In order to remove the cuttings produced by the action of the bit, a drilling fluid is injected downwardly through the drill string into the bottom of the borehole and is withdrawn through the annular space between the drill string and the borehole wall.

Although a wide variety of drill bits of different designs are employed in rotary drilling operations in order to secure maximum cutting efficiency in various formations, one of the types most frequently used is the drag bit. In general, this type of bit comprises an essentially cylindrical body section, a shank section by means of which the bit may be attached to a drill string, and elongated blade members which extend downwardly from the body of the bit. Nozzles in the lower surface of the body section which communicate with the bore of the bit provide for the entry of drilling fluid from the drill string into the borehole.

In order to achieve maximum efficiency during rotary drilling operations carried out with a drag bit in this manner, it is essential that the cuttings from the formation be entrained in the drilling fluid and carried out of the cutting area as soon as they are produced. The distance above the bottom of the borehole at which the drilling fluid emerges from the bit is an important factor in determining the success with which this is accomplished. If the drilling fluid enters the borehole too far above the bottom, the cuttings are not efficiently entrained in the circulating fluid and hence the effectiveness of the bit is impaired. In the conventional drag bit the height of the nozzles above the bottom of the borehole, sometimes referred to as the nozzle standoff, is governed by the length of the blades of the bit and hence it is necessary that the blades be relatively short. Drag bits wear rapidly while drilling through hard formations and, because of their short blades, must be replaced at frequent intervals. Such replacements necessitate that the entire drill string be pulled out of the borehole and are therefore costly.

The present invention provides a new and improved drag bit for use in rotary drilling which is fitted with self-adjusting nozzles adapted to maintain constant nozzle standoff during the entire life of the bit. Sliding tubes extending downwardly from the body of the bit of the invention serve as nozzles through which the drilling fluid passes from the interior of the bit into the borehole. The sliding tubes are supported by a guide shoe which slides vertically in fixed lateral relationship to the bit blades. The guide shoe rests upon the formation during drilling

and maintains the nozzle outlets at a constant level or standoff above the bottom of the borehole. Since the position of the nozzle outlets above the borehole bottom is thus independent of the length of the blades of the bit, the invention permits the use of much longer blades than can be employed on conventional drag bits, extending bit life and reducing the frequency with which the drill string must be pulled to replace the bit.

The nature and objects of the invention will be more fully understood from the following detailed description and the accompanying drawing, in which:

FIGURE I is an elevational view, partly in section, of one embodiment of a drill bit constructed in accordance with the invention;

FIGURE II is a bottom view of the apparatus of FIGURE I, and,

FIGURE III is a fragmentary sectional view of the nozzle tubes, guide member and shoe of a bit constructed in accordance with the invention showing a further embodiment.

Referring now to the drawing, it can be seen that the bit of the invention is in general similar to conventional drag bits and comprises a generally cylindrical body section **11** with an upper shank **12** and elongated flat blade members **13** extending downwardly below the body. The shank is provided with threads **14** so that it may be connected to the lower end of a conventional section of drill pipe or drill collar. The upper part of body section **11** and shank **12** contain a vertical bore **15** into which drilling fluid, a conventional "mud" consisting of a suspension of clay and various additives in water for example, may pass from the drill string above. Extending downwardly from bore **15** through the body of the bit are passages **16**, which emerge adjacent to the blades.

Tubular nozzles **17** are slideably positioned in passages **16** and are retractable into the base of the bit. The nozzles are provided with enlarged sections **18** at the upper ends thereof in order to prevent their slipping out of the passages. O-ring seals **19** of rubber, plastic, hemp or the like which are seated in annular grooves **20** in the body section may be provided in order to assure a fluid-tight connection between the nozzles and the body. The nozzles preferably fit tightly within passages **16**, however, and in many cases such seal rings will be unnecessary. The nozzles may also be provided with hardened liners **21** of alloy steel or similar material in order to reduce wear at the lower ends due to the passage of the drilling fluid therethrough.

Nozzles **17** are secured at their lower ends to a guide member **22** which is retained beneath the body of the bit in vertically slideable relationship to the blades **13**. The guide member may be shaped to slide vertically between the blades, as more clearly shown in FIGURE II of the drawing, or may instead be designed to fit around and slide upon one or more of the blades. In either case, the guide member is free to move in a vertical direction only. The nozzles may be welded or otherwise permanently attached to the guide member or, in lieu thereof, may be connected thereto by threads or other means which will permit rapid disassembly of the moving parts of the bit. The latter arrangement is shown in FIGURE III of the drawing, wherein the nozzles **17** are provided with threads **23** which mate with similar threads inside openings **24** in the guide member. Attached to the bottom of guide member **22** is shoe **25** which is preferably made of hard alloy steel and which serves to position the guide member and ends of the nozzles at the proper level above the lower ends of blades **13**.

During drilling operations carried out with the improved bit of the invention, shoe **25** rests upon the formation at the bottom of the borehole, even with the ends of

the blades of the bit. Drilling fluid passed downwardly through the drill string traverses bore **15** and nozzles **17** and emerges into the borehole, from which it is withdrawn, together with cuttings produced by the bit, through the annular space surrounding the drill string. As the blades of the bit wear during drilling, the shoe **25** and guide member **22** are gradually forced upward by the pressure against the formation. The nozzles **17** retract into the bit in response to this upward motion. Since the distance between the ends of the nozzles and the bottom of shoe **25** does not appreciably change, the standoff of the nozzles above the bottom of the borehole is essentially constant during the entire drilling operation. This constant standoff assures efficient removal of cuttings regardless of the wear on the blades of the bit and permits the use of much longer blades than could otherwise be employed. As pointed out heretofore, this use of longer blades reduces the frequency with which the drill string must be pulled out of the borehole in order to change bits and hence makes possible substantial reductions in the cost of the overall drilling operation.

It will be understood that a number of modifications may be made in the apparatus specifically described herein without departing from the scope of the invention. The blades of the bit may, for example, be provided with inserts or facings containing diamonds or other hard abrasive particles in order to improve the cutting action and increase blade life. The position and number of nozzles employed may be altered in order to change the fluid flow pattern within the borehole. These and similar modifications will be apparent to those skilled in the art. It is intended that the scope of the invention be limited only by the appended claims.

What is claimed is:

1. A rotary drill bit which comprises a hollow body section attachable to the lower end of a drill string; blades connected to and depending from said body section; a shoe engaging said blades beneath said body section, said shoe being restrained from lateral movement by said blades and being slidable with respect to said blades and body section; means for limiting downward movement of said shoe with respect to said blades and body section; a nozzle supported by said shoe and movable therewith; and means for transmitting fluid from within said body section to said nozzle.

2. A rotary drag bit which comprises a hollow body section attachable to the lower end of a drill string, said body section containing an upper opening and a lower opening through which fluid may be circulated; blades connected to and depending from said body section; a shoe engaging said blades beneath said body section, said shoe being restrained from lateral movement by said blades and being slidable with respect to said blades and body section; means for limiting downward movement of said shoe with respect to said blades and body section; and a nozzle supported by said shoe beneath said body section, said nozzle extending through said lower opening into said body section and being axially slidable within said lower opening.

3. A rotary drag bit comprising a hollow body section attachable to the lower end of a drill string, said body section containing an upper opening into which fluid may pass from said drill string and a lower opening through which fluid may be discharged; blades attached to and depending from said body section; a shoe slidably positioned between said blades beneath said body section, said shoe containing notches into which said blades extend inwardly; means for limiting movement of said shoe with respect to said blades and body section; and a nozzle supported by said shoe beneath said body section, said nozzle extending into said body section through said lower opening and being axially slidable within said lower opening.

References Cited in the file of this patent

UNITED STATES PATENTS

2,279,129 Pennington ---------- Apr. 7, 1942