

Sept. 21, 1965

W. J. NEILSON

3,207,241

JET BITS

Filed April 8, 1963

2 Sheets-Sheet 1

FIG. 2.

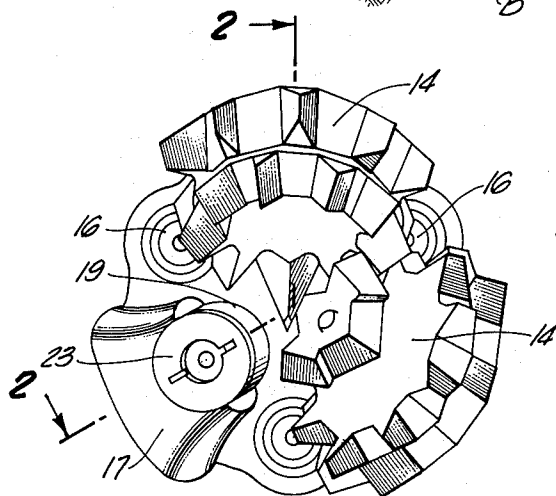
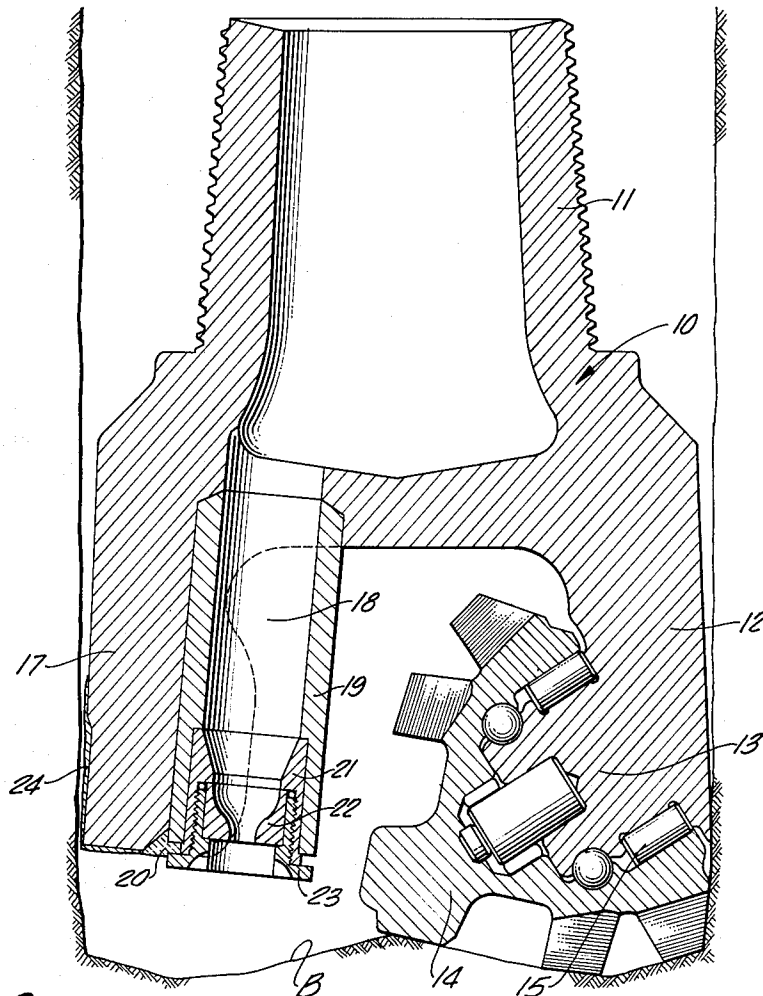


FIG. 1.

INVENTOR
WILLIAM J. NEILSON

BY *Hazard & Miller*
ATTORNEYS

Sept. 21, 1965

W. J. NEILSON

3,207,241

JET BITS

Filed April 8, 1963

2 Sheets-Sheet 2

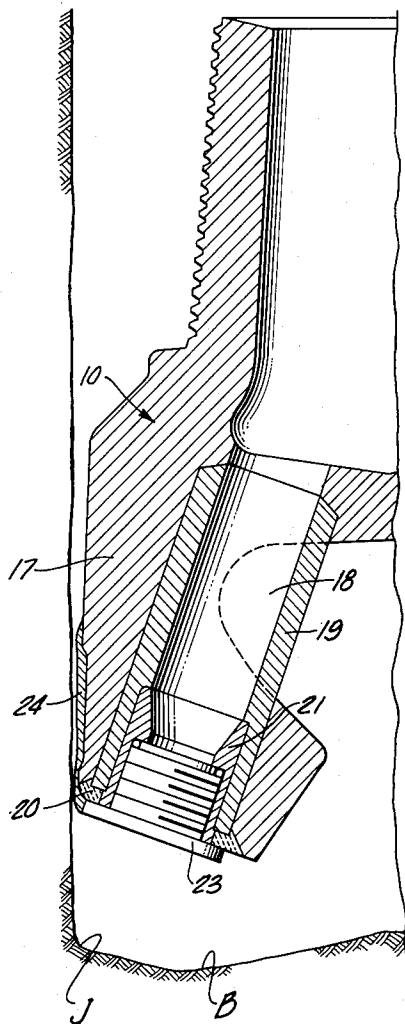


FIG. 3.

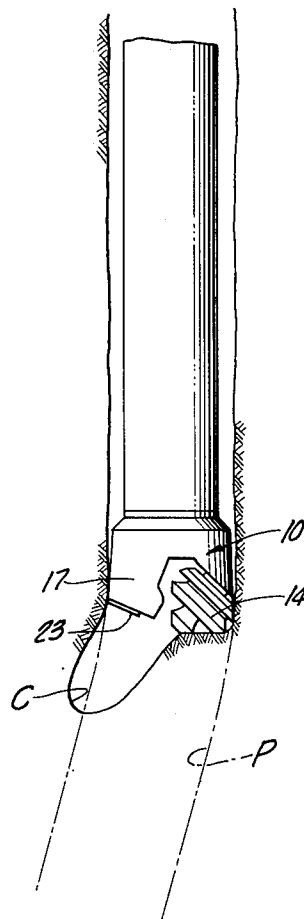


FIG. 4.

INVENTOR
WILLIAM J. NEILSON

BY

Hazard & Miller
ATTORNEYS

1

3,207,241
JET BITS

William J. Neilson, Whittier, Calif., assignor to Smith Tool Co., Compton, Calif., a corporation of California
Filed Apr. 8, 1963, Ser. No. 271,307
1 Claim. (Cl. 175—340)

This invention relates to improvements in well drilling bits, and in particular to that class of bits commonly referred to as jet bits.

One form of conventional well drilling bit consists of a body having three downwardly extending legs on which are formed inwardly extending journals. Cutters which are usually toothed are rotatably mounted on the journals and as the body is rotated these cutters penetrate and remove fragments of the formation being drilled. Circulation fluid is pumped down the drill stem and is discharged through one or more circulation ports which circulation fluid performs a number of functions including washing the cuttings upwardly, cooling the bit, and washing the teeth of the cutters.

During recent years it has been proposed to constrict or reduce the size of the circulation ports so that by forcing the circulation fluid down the drill stem at high velocity and under high pressure, jet streams will be discharged downwardly toward the bottom of the hole being drilled. These jet streams are intended to wash away the formation being penetrated as much as possible, thus reducing the work that must be done by the roller cutters. However, in the usual roller cutter bit having three or four roller cutters, as these are equally spaced around the bottom of the bit they occupy so much of the available space that the nozzles through which the circulation fluid is discharged must be located at considerable distance above the bottom of the well bore. This distance heretofore has been in excess of six-nozzle diameters. When the bottom of the well bore is filled with circulation fluid and a jet stream is discharged from a nozzle that is spaced more than six-nozzle diameters from the bottom of the hole, the effectiveness of the jet stream is largely dissipated. The stream of circulation fluid that emerges from the nozzle becomes dissipated due to the fact that it accelerates and entrains the surrounding circulation fluid that is present in the well bore. When the nozzle is spaced from the bottom of the well bore more than six diameters its effectiveness to hydraulic away the formation becomes lost quite rapidly, see the article entitled, "Keys to Successful Competitive Drilling," by Roy A. Bobo and Robert S. Hoch that appeared in World Oil for November 1957.

It is consequently highly desirable to provide a well drilling bit which is so designed that circulation fluid will be conducted from the drill stem through a confined passage and emerge through a nozzle that is located very close to the bottom surface of the well hole that is being drilled. For most efficient operation, the spacing of the nozzle from the bottom surface of the well hole should be less than six diameters.

A primary object of the present invention is to provide an improved well drilling bit which will accomplish the above-mentioned desiderata.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claim, reference is had to the accompanying drawings for an illustrative embodiment of the invention, wherein:

FIGURE 1 is a bottom plan view of one form of well drilling bit embodying the present invention;

FIG. 2 is a vertical section taken substantially upon the line 2—2 upon FIG. 1;

FIG. 3 is a partial view in vertical section similar

2

to FIG. 2, but illustrating an alternative form of construction; and

FIG. 4 is a vertical section through a well bore illustrating how the bit embodying the present invention may be used in directional drilling.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, the improved bit comprises a hollow body 10 having a threaded pin 11 by which it may be attached to the drill collars of a drill string of a rotary well drilling apparatus. Three legs are shown as extending downwardly from the body 10 which are equally spaced from each other circumferentially. Two of these legs indicated at 12, terminate in downwardly and inwardly extending journals 13 on which toothed roller cutters 14 are rotatably mounted. These are shown as equipped with anti-friction radial and thrust bearings generally indicated at 15. The particular design of the roller cutters and of the bearings that rotatably mounted the cutters on the journals is immaterial insofar as the present invention is concerned.

As will be observed from an inspection of FIG. 1, the two cutters 14 occupy approximately two-thirds of the bottom surface of the bit and in conformity with general practice, nozzles 16 are arranged in the body 10 and communicate with passages leading to its interior through which circulation fluid is discharged downwardly adjacent the sides of the cutters. These nozzles, due to the presence of the cutters, are usually required to be spaced more than six-nozzle diameters from the bottom hole surface B, and because of the spacing their effectiveness to wash away or hydraulic away the formation at the bottom hole surface B is largely dissipated. The jets issuing from the nozzle 16 while they may perform this function to a slight extent, nevertheless are largely used for washing cuttings upwardly and also for washing the teeth on the cutters.

In accordance with the present invention the third leg 17 does not terminate in a downwardly and inwardly extending journal as in conventional practice, but extends downwardly to a point approximately even with the bottoms of the journals 13. In this leg there is provided a confined passage 18 that communicates with the hollow interior of the body 10, and this passage may be formed in part by a tube 19 that is welded as at 20 to the leg and located inwardly of the outer surface of the leg. This tube may have in its lower end a nozzle holder 21 that is pressed or otherwise secured in position and which holds a nozzle 22 that is retained in position by a nozzle retainer 23. The nozzle 22 may be formed of hard metal, such as tungsten carbide, or a hard ceramic to resist its being cut by the circulation fluid that is discharged therethrough under high velocity and at high pressure. This nozzle is directed downwardly against the bottom hole surface B, and the point at which the stream of circulation fluid issues from the nozzle is spaced from the surface B only a short distance. In the preferred form of construction this distance is less than six diameters of the nozzle. The closer that the nozzle may be to the surface B the less the stream will be dissipated on emerging from the nozzle and encountering the surrounding circulation fluid that is in the well bore. The stream is so directed as to encounter the bottom hole surface in the tracks of the cutters. This stream on encountering the bottom hole surface B will wash away a substantial amount of the formation as the bit is rotated, thus relieving to a large extent in many formations the work that must be done by the cutters 14.

Increased fluid velocity across the bottom of hole also improves the removal of cuttings cut by the cutters. Higher velocity permits the lifting of larger cuttings

3

which otherwise would require recutting, thereby increasing drilling efficiency.

It will be appreciated that with this type of bit that the bit is non-symmetrical with relation to a vertical central axis. Consequently, the leg 17 may be left relatively broad or may be made broader than the leg 12 so that it may function as a stabilizing pad when it engages the vertical walls of the well bore. To this end, the lower end of leg 17 is preferably externally coated with hard facing metal 24 applied thereto, such as by welding, so as to resist abrasion.

In the form shown in FIG. 2 the axis of the stream that emerges from the nozzle 22 is directed against the bottom hole surface B inwardly of the walls of the hole. In the construction shown in FIG. 3 the construction is the same as that disclosed in FIG. 2, except that the axis of the tube 19 and of the nozzle held therein is such that the emerging stream is directed against the juncture J between the bottom hole surface B and the well wall.

During normal operations the bit is rotated by the drill string in the conventional manner. Where the formation that is being drilled is such that it can be washed away or hydrauliced away by the stream of circulation fluid most of this is accomplished by the jet that issues from the nozzle 22. Where this cannot be accomplished by the jet the formation may be drilled by means of the cutters 14 in the conventional manner. Either construction can be advantageously employed in directional drilling. Thus, as illustrated in FIG. 4, if it is desired to drill the well in a designated direction, either form of bit may be lowered into the well to the well bottom and oriented by conventional surveying equipment so that the nozzle 22 will be directed in the direction that it is desired that the well bore proceed. The bit and drill string can be left stationary in this position while circulation fluid is pumped down the drill string and discharged through the nozzle. This will cause a cavity C to be washed in this side of the well hole and after such a cavity has been formed, the bit and drill string are again rotated as in conventional drilling. Due to the reduced resistance occasioned by the cavity C, the bit and drill string will be diverted from vertical and proceed along the path P.

From the above-described construction it will be appreciated that an improved well drilling bit has been provided which enables circulation fluid to be discharged from a nozzle located very close to the surface of the formation that is to be drilled. By reason of the fact that the jet is so close to the bottom hole surface its effectiveness is not dissipated or lost by the surrounding

4

circulation fluid as would be the case if the nozzle were most remotely located with reference to the bottom hole surface.

While the invention has been disclosed as incorporated in a bit having three downwardly extending legs, two of which have journals and rotatable cutters, it will be appreciated that it may be incorporated in a bit employing four equally spaced, downwardly extending legs. In the latter event, three of the legs may have cutters rotatably mounted thereon and the fourth may be employed to provide the confined, downwardly extending circulation passage terminating near the bottom hole surface cut by the bit.

Various changes may be made in the details of construction without departing from the spirit and scope of the invention as defined by the appended claim.

I claim:

A well drilling bit comprising a body having three equally spaced legs extending downwardly therefrom approximately the same distances, journals on the lower ends of two of the legs extending downwardly and inwardly therefrom, roller cutters rotatably mounted on the journals, the third leg having a circulation fluid passage associated therewith terminating approximately even with the lower end of the third leg and directed downwardly therebeneath, a nozzle of hard abrasion resisting material in the lower end of said passage having an internal diameter smaller than that of the remainder of the passage, said nozzle being located not more than six of its internal diameters above the bottom hole surface cut by the cutters and being directed against the tracks of the cutters on the bottom hole surface, the body having additional circulation fluid passages terminating above the cutters and directed downwardly adjacent the sides of the cutters.

References Cited by the Examiner

UNITED STATES PATENTS

1,121,573	12/14	Wetzel	175—399
2,066,671	1/37	Catland	175—339
2,335,929	12/43	Fortune	175—340
2,754,091	7/56	Kucera	175—340
2,873,092	2/59	Dwyer	175—340
2,901,223	8/59	Scott	175—340
3,104,726	9/63	Davis	175—341
3,113,630	12/63	Williams	175—340

CHARLES E. O'CONNELL, *Primary Examiner.*

BENJAMIN HERSH, *Examiner.*