Dec. 10, 1957 R. G. PETER ET AL 2,815,936

DRILL BITS

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Fig. 1

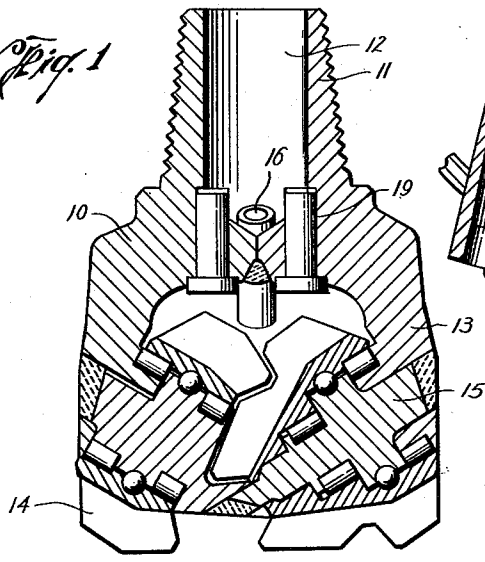



Fig. 3

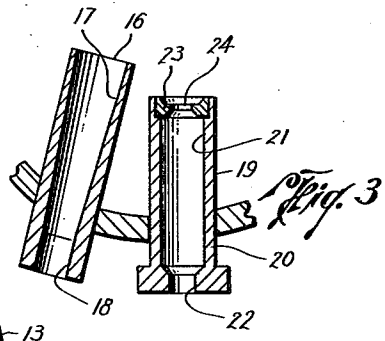



Fig. 2

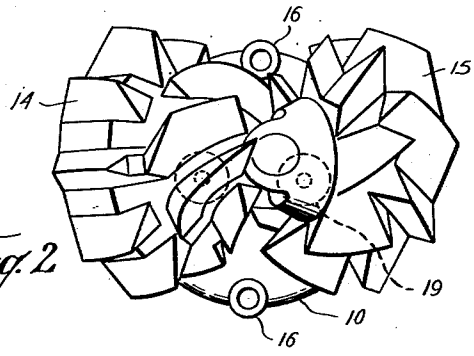



Fig. 4

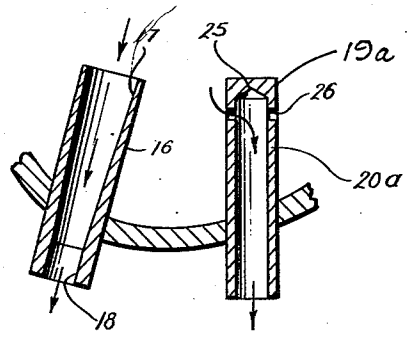
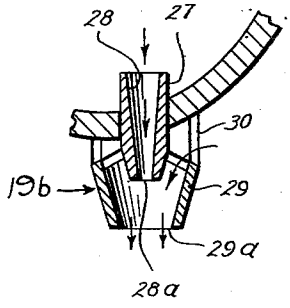



Fig. 5

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# DRILL BITS

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5 Claims. (Cl. 255—313)

This invention relates to new and useful improvements in drill bits.

The invention relates particularly to a slush nozzle arrangement for drill bits whereby the drilling fluid is directed in a manner to increase the drilling efficiency of the bit.

In recent drilling practices it has been found that the use of high velocity mud streams for washing and eroding the bottom of the hole provides a particular advantage in the drilling operation since the high velocity jet impinging upon the bottom of the hole assists in removing the formation. Therefore, the trend has been toward the use of higher mud pressures in order to obtain the high velocity jet streams which discharge onto the bottom of the hole. Although these high velocity streams have increased drilling efficiency it is obvious that such high velocity streams cannot be directed to impinge upon the drilling cutters because such impingement would result in excessive wear of the cutters and the cutter teeth. By directing the high velocity streams onto the bottom of the hole and away from the cutters, cleaning of the cutter teeth has been sacrificed with a resultant loss in the cutter efficiency. Thus, although overall drilling efficiency has been gained by the use of the high velocity mud streams, some loss in reduced cutter efficiency has been sustained.

It is one object of the present invention to retain all of the advantages of the use of high velocity mud streams impinging upon the bottom of the hole and at the same time to provide a lower velocity stream for impingement against the cutters to maintain said cutters and their teeth clean to permit them to function at full efficiency.

An important object is to provide a dual nozzle arrangement wherein from a single fluid source a high volume high velocity stream may be directed upon the bottom of the hole and a relatively low volume and low velocity stream may be simultaneously discharged upon the cutters and cutter teeth, whereby maximum drilling efficiency is obtained.

Another object is to provide a dual nozzle arrangement for drill bits wherein the circulating fluid or mud is conducted to a nozzle having means for dissipating the energy of the circulating fluid whereby a low velocity stream of lesser volume may be directed onto the cutter teeth to assure cleaning thereof without excessive cutting out or wear because of the abrasive action of the stream.

Other objects will hereinafter appear.

Figure 1 is a transverse vertical sectional view of a drill bit constructed in accordance with the invention,

Figure 2 is a bottom view of the bit,

Figure 3 is an enlarged sectional view schematically showing the dual nozzle arrangement,

Figure 4 is a schematic view similar to Figure 3 showing a slightly modified form of the invention, and

Figure 5 is a sectional view of still another modification of the low velocity nozzle.

In the drawings the numeral 10 designates the body of



a drill bit having the usual externally threaded pin 11 at its upper end. The pin is provided with a bore which forms a chamber 12 within the upper portion of the bit, which chamber is in communication with the drill pipe (not shown) to which the bit is attached. The body of the bit is formed with the usual depending legs 13 and cutters 14 are mounted on supporting spindles 15 which extend inwardly from the legs 13. The particular construction of the bit, the cutters and the mounting of said cutters is subject to variation.

It is desirable that high velocity fluid streams or jets be directed downwardly onto the bottom of the hole during the drilling operation to wash away and erode the formation, and it is also desirable that low velocity streams be directed onto the cutters 14 to maintain the cutting teeth in a clean condition. It might be noted that the high velocity streams are preferably of a high volume while the low velocity streams need only be of a lesser volume.

For directing a high volume high velocity stream or jet of drilling fluid or mud onto the bottom of the hole a tubular nozzle 16 is mounted in the bit body and has its upper end in communication with the chamber 12 in the upper portion of the bit, whereby drilling fluid may be directed downwardly through the nozzle. The lower end of the nozzle is located to discharge the stream flowing therethrough onto the bottom of the hole at a point between the cutters 14. As illustrated in Figure 2, two of the nozzles 16 are provided but obviously the number employed may vary. Each nozzle has its bore gradually tapered as indicated at 17 in Figure 3 with the discharge end 18 of said bore being of a diameter in accordance with the particular velocity which is desired. It is evident that control of the volume of fluid as well as the velocity which is discharged through each nozzle 16 is obtained through the diameter of the bore of the nozzle, together with the diameter of the discharge end 18 thereof. As noted, each nozzle discharges its fluid stream upon the bottom of the hole at a point between the cutters so that the high volume high velocity streams do not impinge upon the cutters 14 or the cutter teeth.

For directing a stream of fluid of lesser volume and lesser velocity upon the cutters for the purpose of cleaning said cutters, an additional nozzle 19 is provided for each cutter. Each nozzle 19 comprises a conduit or tube 20 having a bore 21 of predetermined diameter. The outlet end of each tube is counterbored at 22 to provide a discharge opening of predetermined size. Within the upper end of the tube 20 is mounted an orifice plate or collar 23 having an opening 24 of predetermined size therein. The plate or collar may be constructed of hard metal to prevent excessive cutting out or wear thereof.

As the pressure fluid or mud which is circulated downwardly through the drill pipe and chamber 12 enters the restricted opening 24 in the element 23 a pressure drop occurs across said opening. This results in a dissipation of energy so that the velocity of the fluid flowing through the bore 21 of the nozzle tube 20 is reduced. The discharge end 22 of the nozzle tube then controls the velocity of the stream which is discharged therefrom. Each nozzle 19 is mounted within the bit body to direct the stream discharged therefrom onto the cutter teeth of the cutter therebelow, and it is evident that the stream so discharged is of lesser volume and lesser velocity than the streams discharged from the nozzles 16. It is also evident that by controlling the size of the tube, the diameter of the control orifice 24 and the diameter of the discharge end 22, a stream of any desired velocity and volume may be obtained.

The nozzles 16 and 19 may be mounted in the bit in any suitable manner and as illustrated extend through openings in the bit body being welded in final position

therein. Ordinarily, the nozzles **16** and **19** are not mounted in the same plane and therefore Figure 3 is a schematic view which does not intend to show the nozzles **16** and **19** in their exact or true relationship; the schematic view is provided for purposes of illustration only to show the construction of each of said nozzles.

From the foregoing it will be seen that a nozzle arrangement is provided whereby a stream or streams of high volume high velocity may be directed upon the bottom of the hole while a stream or streams of lesser volume and lesser velocity may be directed upon the cutters, with all nozzles having a common source of fluid supply. In this manner the high velocity jets or streams impinging upon the bottom of the hole assists the cutters in the drilling operation, while the lesser volume low velocity streams maintain the cutters in clean condition without cutting out the teeth or causing excessive wear thereof.

A modification of the invention is schematically illustrated in Figure 4 wherein nozzles **19***a*, functioning in a manner similar to nozzles **19**, are constructed of a tube **20***a* having its upper end **25** closed. Restricted openings or orifices **26** extend radially through the tube **20***a* and are in communication with the chamber **12** of the bit body. The orifices **26** function in the same manner as the orifice **24** of the first form in that a pressure drop is created thereacross which results in a reduction of the velocity of the flowing fluid. The same principle of operation which is a dissipation of the energy is utilized in the form shown in Figure 4. By controlling the size of the orifices **26**, the velocity of the discharging stream is controlled.

In Figure 5 still another modification is illustrated. In this form a nozzle assembly **19***b* which may be substituted for the nozzles **19** and **19***a* of the forms heretofore described, comprises a tube **27** having a tapered restricted bore **28** extending from the chamber **12** of the bit body to the area above the cutters **14**. A tapered collar **29** surrounds the discharge end **28***a* of the tube **27**, this collar being attached through supporting arms **30** to the bit body. As indicated by the arrows, the fluid stream discharging from the tube **27** will create a suction effect at the upper end of the tapered collar **29** and will function to draw additional fluid into the upper end of the collar. This additional volume of fluid admixing with the stream ejecting from the tube **27** will act to dissipate the energy of the stream and will result in a low velocity stream discharging from the lower end **29***a* of the collar.

In all forms of the invention the high velocity high volume streams are discharged onto the bottom of the hole through the nozzle **16** and the particular volume and velocity of said streams is controlled by the construction of said nozzles; the streams of lesser volume and low velocity are discharged through the nozzles, which may be constructed in the manner of the nozzles **19**, **19***a* or **19***b* as shown in Figures 3, 4 and 5, respectively, and such low velocity streams function to maintain the cutters in a clean condition to assure maximum cutting efficiency.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction may be made, within the scope of the appended claims, without departing from the spirit of the invention.



Having described the invention, we claim:

1. The combination with a drilling bit including a bit body having a cutter thereon of a nozzle assembly including, a tubular nozzle conduit having a tapered bore for discharging a high velocity stream onto the bottom of the well bore, a second tubular element having a substantially constant diameter bore for discharging a low velocity stream upon the cutter, and means at the inlet end of the latter conduit for restricting the fluid entering said latter conduit.

2. The combination with a roller type rock bit of a nozzle assembly including, a plurality of high velocity nozzles for discharging a high velocity fluid stream onto the bottom of the well bore, each including a tubular conduit having a tapered bore, a plurality of low velocity nozzles for discharging a low velocity fluid stream onto the roller bit each low velocity nozzle comprising a tube having a bore of substantially constant diameter and means at the inlet end of said tube for restricting the flow of fluid into the tube to create a pressure drop across said restriction.

3. The combination with a roller type rock bit of a nozzle assembly including, a plurality of high velocity nozzles for discharging a high velocity fluid stream onto the bottom of the well bore, each including a tubular conduit having a tapered bore, a plurality of low velocity nozzles for discharging a low velocity fluid stream onto the roller bit each low velocity nozzle comprising a tube having a tapered bore and an annular collar surrounding the discharge end of said tube and having its bore tapered and spaced from the exterior surface of the tube.

4. A drill bit including a bit body having a cutter thereon, a nozzle in the bit body for discharging a fluid stream to one side of said cutter, and a second nozzle in said body for discharging a fluid stream upon the said cutter, said second nozzle comprising a tube having a cap on the inlet end thereof and having an orifice extending radially through the wall of said tube near the inlet end thereof, to reduce the velocity of the fluid stream discharging from the said second nozzle.

5. A drill bit including, a bit body having a cutter thereon, a nozzle in the bit body for discharging a fluid stream to one side of said cutter, and a second nozzle in said body for discharging a fluid stream upon the said cutter, the second nozzle comprising a tube having a closure on the inlet end thereof, the inlet end of said second nozzle having a plurality of orifices therethrough, the said orifices being arranged so that fluid passing inwardly through one of said orifices will impinge the fluid passing inwardly through the other of said orifices.


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