June 16, 1964 A. W. CRAWFORD ETAL 3,137,354

DRILL BIT NOZZLES

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Fig. 1

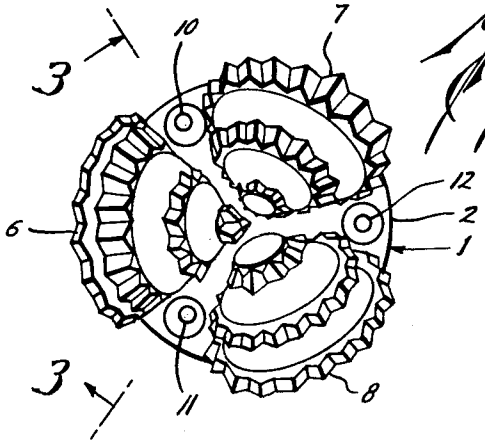


Fig. 2

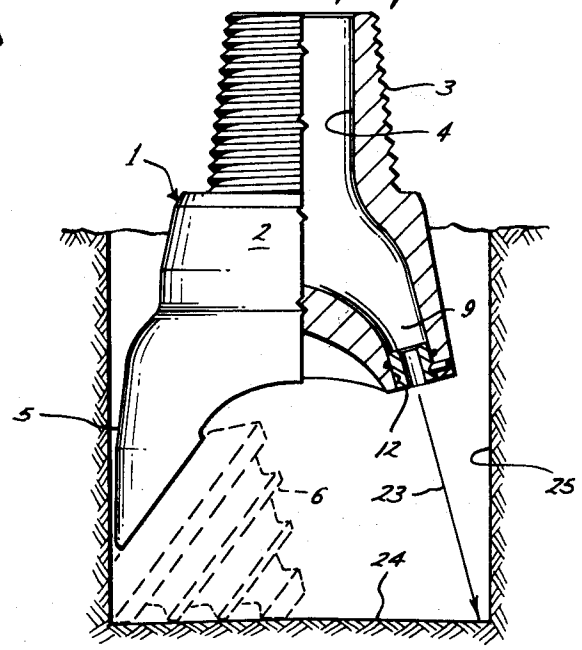
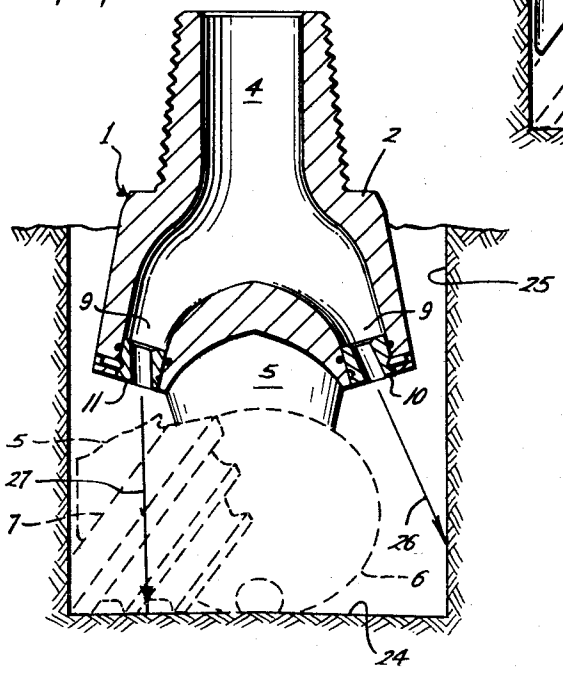


Fig. 3



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Fig. 4

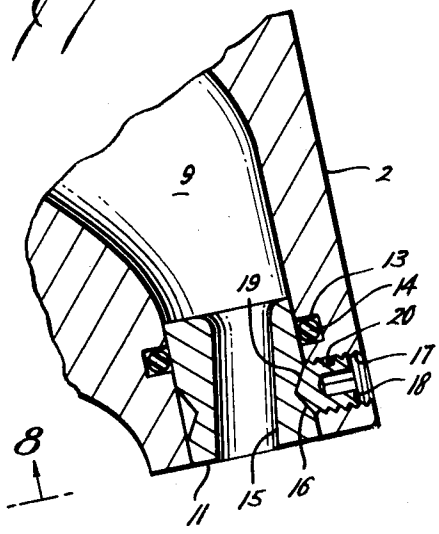


Fig. 5

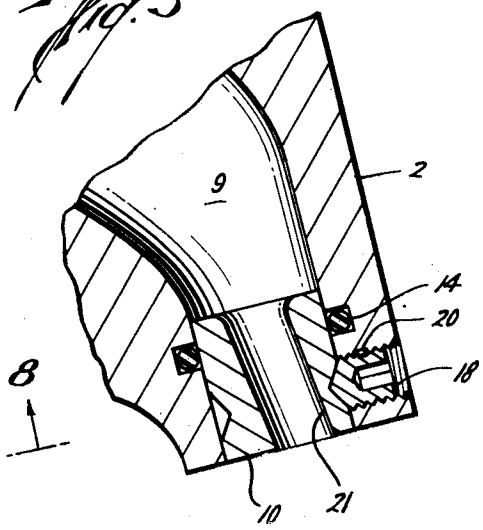


Fig. 8

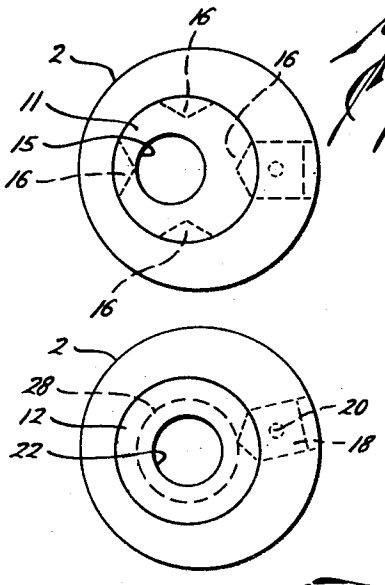


Fig. 6

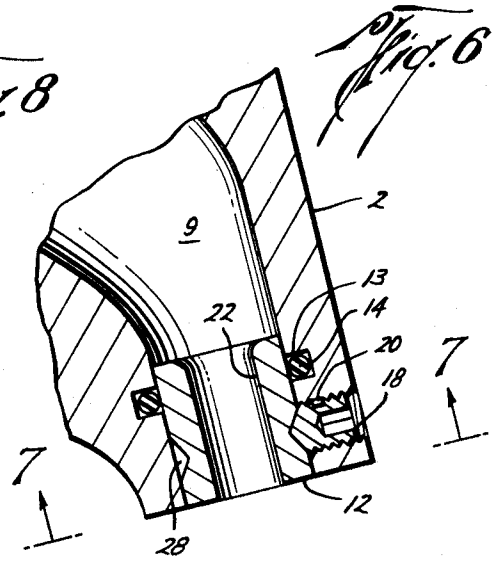


Fig. 7

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DRILL BIT NOZZLES

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5 Claims. (Cl. 175—340)

This invention relates generally to roller drilling bits and more particularly to drilling fluid nozzles therefor.

In the drilling of deep wells, a rotary bit is connected to the lower end of a drill stem which is rotated to cause the drill bit rollers to roll upon the bottom of a bore hole and thereby cut or crush the formation being encountered. A drilling fluid is pumped downwardly through the drill stem and bit and rises upwardly in the annular space between the drill stem and the wall of the hole to the surface of the earth. One of the most important desired functions of the drilling fluid thus circulating is quickly to remove the cut or crushed particles of the formation from the bottom areas of the bore hole and from the rollers and adjacent parts of the bit.

This invention has for one of its general objects the provision of a new and improved fluid nozzle arrangement to perform the desired function of quickly removing the particles of formation from the bottom areas of the bore hole and from around the drill bit.

Another object is to provide a new and improved roller drill bit having drilling fluid circulating means which will clean the bottom of the hole more efficiently and which will alleviate the recutting of formation particles after they have been dislodged from the formation.

Another object is to provide a drill bit having a drilling fluid nozzle arrangement to direct fluid to agitate more thoroughly formation cuttings in the bottom of the bore hole.

Another object is to provide a new and improved fluid nozzle arrangement wherein some or all of the nozzles may be individually positioned to direct fluid to impinge the formation in preselected circular paths.

Another object is to provide a new and improved drill bit nozzle which may be readily installed or removed from the exterior of the bit head and which may be retained within the bit head in a predetermined axial and angular position by means of a single set screw.

Another object is to provide in the bit head a larger and more efficient fluid passageway leading to the nozzle.

Another object is to provide a drill bit fluid nozzle arrangement wherein the drill bit nozzles may be readily salvaged from a worn or dull bit.

Other objects will become apparent from the following description and the accompanying drawings in which:

FIG. 1 is a bottom plan view of a cone-type well drilling bit.

FIG. 2 is a side elevational view, shown partly in section, of the drill bit shown in FIG. 1.

FIG. 3 is a sectional view taken generally on line 3—3 of FIG. 1 and with a portion of the bit being shown rotated into the plane of the paper to illustrate the operating relationship of some of the drill bit parts.

FIGS. 4, 5 and 6 are enlarged broken sectional views showing arrangements of nozzles in the fluid passageways of the drill bit.

FIG. 7 is the view taken on line 7—7 of FIG. 6.

FIG. 8 is a view taken on line 8—8 of FIG. 4.

Referring to FIGS. 1, 2 and 3, a drill bit is shown generally at 1 comprising a bit head 2 and a threaded shank 3, extending upwardly from the bit head 2, for attachment to the lower end of a drill stem (not shown).

The threaded shank 3 has a chamber 4 therein for the reception of drilling fluid.

The bit head 2 has a plurality of downwardly extending legs 5, upon which are rotatably mounted roller cutters 6, 7 and 8 in the usual manner.

The bit head 2 may have a plurality of fluid passageways 9 which communicate with the chamber 4. Within the lower ends of the fluid passageways 9 are provided fluid nozzles 10, 11 and 12 which direct fluid to one side of the said cutters. These nozzles usually are composed of tungsten carbide or other wear resistant material so that they are not easily eroded away by the action of the drilling fluid passing therethrough.

Referring to FIG. 4, the nozzle 11 is shown positioned within the lower end of the passageway 9. The wall of the passageway 9 may have an annular groove 13 therein, within which is positioned an annular seal 14 which may be composed of rubber or the like to prevent fluid leakage between the nozzle and the wall of the passageway 9.

The nozzle 11 is generally of cylindrical exterior configuration and has a bore 15 extending therethrough. The axis of the bore 15 describes an angle with the cylindrical axis of the nozzle. The nozzle 11 may have its periphery formed with a plurality of spaced depressions or sockets 16 to successively receive the inner end of the set screw 18, whereby the nozzle may be held in any one of a number of angular positions. The spacing of four sockets or depressions is illustrated by FIG. 8, but it will be understood that any number of sockets and any spacing thereof may be employed, depending upon the angles at which the passageway 15 of the nozzle 11 is to be held. Or, if desired, an annular groove such as the groove 28 disclosed by FIGS. 6 and 7 may be employed.

The bit head 2 has a threaded bore 17 which extends radially from the passageway 9 to the exterior surface of the bit head 2. Threadedly engaged within the bore 17 is an internal wrenching set screw 18 which is shaped as at 19 to register with and engage the depression or socket 16 of the nozzle 11. The set screw 18 has in its exterior surface a plug 20, which may be composed of "nylon" or the like. Upon threading the set screw 18 into the bore 17, the plug 20 will resiliently engage the threads of the bore 17 in order to prevent the set screw 18 from being inadvertently backed out of the threaded bore 17. The set screw 18 serves to hold the nozzle 11 in a predetermined axial and angular position within the passageway 9. The bore 15 of the nozzle 11 directs drilling fluid passing therethrough at an angle downwardly and inwardly with respect to the cylindrical axis of the nozzle 11.

In FIG. 5, the nozzle 10 is shown having a bore 21 therethrough. As can be seen, the axis of the bore 21 describes an angle with the cylindrical axis of the nozzle 10 and is positioned to direct drilling fluid downwardly and outwardly with respect to the cylindrical axis of the nozzle 10. The nozzle 10 is held, positioned and sealed in the fluid passageway 9 in a manner similar to that of the nozzle 11 above described.

In FIGS. 6 and 7, a nozzle 12 is shown having an axial bore 22 therethrough which will direct drilling fluid substantially parallel to the cylindrical axis of the nozzle 12. The nozzle 12 may be shaped as at 28 and is held and sealed in a manner similar to that of nozzles 10 and 11 previously described.

In operation, a drilling fluid is pumped downwardly through the drill stem (not shown) and enters the chamber 4 of the drill bit 1. The drilling fluid then enters the passageways 9 and is directed through the nozzles 10, 11 and 12 to the exterior of the bit.

As can be seen in FIG. 2, the nozzle 12 directs drilling fluid in a direction shown by the arrow 23. Thus the drilling fluid impinges the bottom 24 of the bore hole in a circular path, as the drill bit is rotated. This path is near the wall 25 of the bore hole, and the fluid will

clean a track made by the outer, or heel, teeth of the roller cutters 6, 7 and 8.

As is shown in FIG. 3, the nozzle 10 will impinge fluid in a circular path upon the wall 25 of the bore hole in a direction shown by the arrow 26. The impingement of the fluid issuing from the nozzle 10 thus describes a path radially outboard from that described by the nozzle 12, as the bit is rotated. The nozzle 11 directs fluid substantially as shown by the arrow 27. Thus the nozzle 11, as the bit is rotated, impinges drilling fluid in a circular path on the bottom 24 of the bore hole, which path is inboard and different from the paths of the fluid issuing from the nozzles 10 or 12.

This nozzle arrangement provides for more effective cleaning of the bottom portion of the bore hole in that the fluid issuing from the nozzles cleans and agitates the cuttings from a radially wide circular path.

Depending upon the formations being encountered and the existing drilling conditions, it may be desirable to utilize the nozzles 10 and 12, for instance, so that a large portion of the drilling fluid would not impinge upon the cutters 6, 7 and 8. If the drilling fluid does not possess a high sand content or other abrasive material, one or more of the nozzles 11 may be utilized so that some of the drilling fluid may be directed between the cutters 6, 7 and 8 and in a circular path which is nearer to the longitudinal axis of the bore hole. It will be apparent that the nozzles 10 and 11 may be turned within the passageways 9 and then secured by the set screws 18 to provide for various fluid flow patterns.

This invention is not limited to the embodiment shown. Other arrangements within the scope of the following claims will occur to those skilled in the art.

We claim:

1. In a rotary drill bit, a bit head having roller cutters mounted thereon and a downwardly directed drilling fluid passageway, a cylindrical wear-resistant nozzle in the lower end of said passageway, the said nozzle having a bore therethrough, the axis of the said bore being at an angle with respect to the cylindrical axis of the said nozzle, an annular seal between the nozzle and the wall of the said passageway, the exterior of the said nozzle having a plurality of circumferentially disposed seating depressions, the said head having a threaded bore extending radially from the said passageway to the exterior of the head, a self-locking set screw in the said threaded bore, the inner end of the said set screw adapted to seat in the said seating depressions to retain the said nozzle within the bit head in a predetermined axial and angular position.

2. In a rotary drill bit, a bit head having roller cutters mounted thereon and a downwardly directed drilling fluid passageway, a cylindrical wear-resistant nozzle in the lower end of said passageway, the said nozzle having a bore therethrough, the axis of the said bore being at an angle with respect to the cylindrical axis of the said nozzle, an annular seal between the nozzle and the wall of the said passageway, the exterior of the said nozzle being formed with circumferentially disposed seating means, the said head having a threaded bore extending radially from the said passageway to the exterior of the head, a self-locking set screw in the said threaded bore, the inner end of the said set screw adapted to seat in the said seating means to retain the said nozzle within the bit head in a predetermined axial and angular position.

3. In a rotary drill bit, a bit head having roller cutters mounted thereon and a plurality of downwardly directed drilling fluid passageways, a cylindrical wear-resistant nozzle in the lower end of each of said passageways, each of the said nozzles having a bore therethrough, the axis of at least one of the said bores being at an angle with respect to the cylindrical axis of the said nozzle, an annular seal between the nozzle and the wall of the said passageway, the exterior of the said nozzles having circumferentially spaced seating depressions, the said head having a threaded bore extending radially from each of the said passageways to the exterior of the head, a self-locking set screw in each of the said threaded bores, the inner ends of the said set screws adapted to seat in the said depressions to retain the said nozzles within the bit head in a predetermined axial and angular position.

4. In a rotary drill bit, a bit head having a plurality of roller cutters mounted thereon and a plurality of downwardly directed drilling fluid passageways, a cylindrical wear-resistant nozzle in the lower end of each of the said passageways, each of the said nozzles having a bore therethrough, an annular seal between each of the nozzles and its passageway, the exterior of each of the nozzles having a plurality of circumferentially disposed seating depressions the said head having a threaded bore extending radially from each of the passageways to the exterior of the said head, a set screw in each of the threaded bores, the inner end of the set screws adapted to seat in the said seating depressions to retain the nozzles within the said passageways, the axes of the bores of at least two of the said bores being at an angle with respect to the cylindrical axis of the nozzle, the said seating depressions of each of the said two nozzles being also in the bit head and cooperating with said set screws to retain said nozzles in a predetermined axial and angular position.

5. In a rotary drill bit, a bit head having roller cutters mounted thereon and a downwardly directed drilling fluid passageway, a wear-resistant nozzle in the lower end of said passageway, the said nozzle having a substantially cylindrical outside diameter and a bore therethrough, the axis of the said bore being at an angle with respect to the cylindrical axis of the said nozzle, an annular seal between the nozzle and the wall of the said passageway, the exterior of the said nozzle being provided with a plurality of circumferentially disposed seating depressions, the said head having a threaded bore extending radially from the said passageway to the exterior of the head, a set screw in the said threaded bore, the inner end of the said set screw adapted to seat in the said depressions to retain the said nozzle within the bit head in a predetermined axial and angular position.

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