

Sept. 17, 1968

M. L. TALBERT

3,401,758

FLOW CONTROL VALVE FOR JET TYPE BITS

Filed Oct. 10, 1966

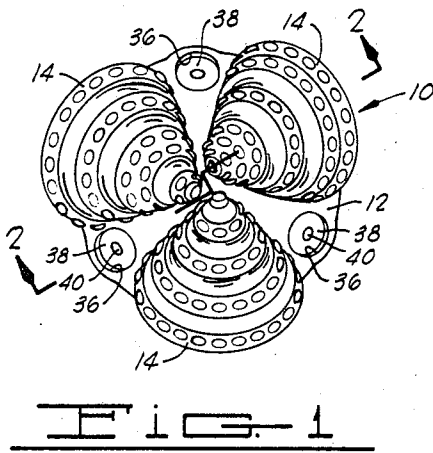


FIG. 1

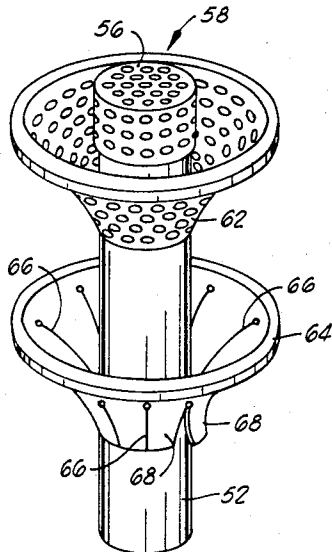


FIG. 3

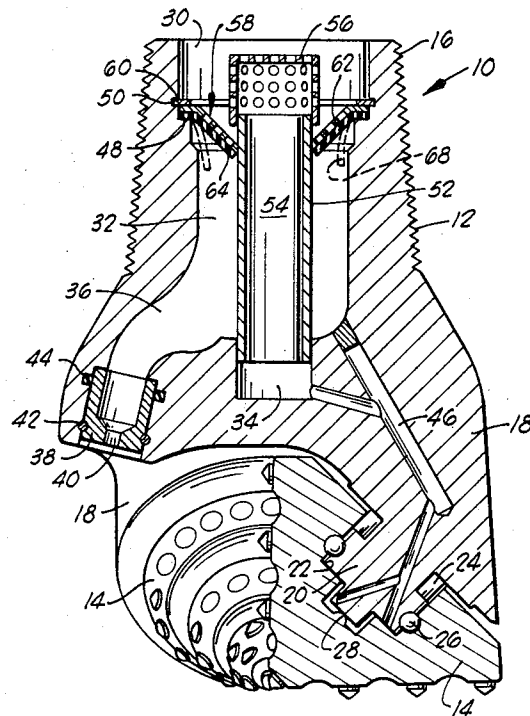


FIG. 2

INVENTOR.
MILTON L. TALBERT

BY
Roy L. Van Winkle
ATTORNEY

1

3,401,758

FLOW CONTROL VALVE FOR JET TYPE BITS
Milton L. Talbert, China Spring, Tex., assignor to Dresser Industries, Inc., Dallas, Tex., a corporation of Delaware
Filed Oct. 10, 1966, Ser. No. 585,490
8 Claims. (Cl. 175—318)

This invention relates generally to improvements in jet type bits employed in the drilling of blast or shot holes in mines, oil and gas wells, and the like. More particularly, but not by way of limitation, this invention relates to an improved flow control valve located in a jet type drilling bit.

Within recent years it has become a relatively common practice to drill mining blast holes, oil and gas wells, and the like utilizing air or gas as the medium for cooling the bit and for carrying cuttings from the bottom of the hole or well bore to the surface. The air is usually displaced downwardly through the interior of a drill string that is connected with the drill bit. The air passes through the drill bit and then upwardly through the annular space between the drill string and the wall of the well bore. If the air circulation is maintained, little or no difficulty is encountered during normal drilling operations.

However, it is necessary to stop drilling from time to time and usually circulation is also stopped. In the event that a water producing zone or formation has been encountered while drilling, stopping the air circulation permits water to rise in the well bore. As the water rises, it flows upwardly through the drill bit and into the interior of the drill string. Loose cuttings formed during the drilling operation are frequently carried with the water into the drill string and bit.

When it is desired to resume drilling, the air is again circulated through the drill string and the drill bit and the cuttings contained in the water may plug the cooling passageways in the bit. Thus, air is prevented from reaching the bit bearings, resulting in overheating and softening of the bearings thereby destroying the usefulness of the bit. When this occurs, it is necessary to remove the drill string from the well and replace the bit. Manifestly, such a procedure is time consuming and very expensive.

Due to the extreme weights exerted on the drill bits, considerable heat is generated in the bearings. Thus, it is essential that a constant and substantial flow of air is maintained through the bearings to prevent overheating and its attendant problems.

Generally, air drilling bits are constructed with one of two types of flow passageways. In one, which is generally referred to as a regular bit, the main stream of air utilized to carry the cuttings from the bottom of the well bore passes through a central opening extending through the drill bit. A plurality of cooling passageways extend from the central opening to a point adjacent the bearings of the bit for the purposes of cooling the bearings.

In the other, which is referred to as a jet type bit, the air stream for carrying cuttings from the bottom of the well bore enters a central recess in the bit and exits therefrom through three jet passageways. The air passes through orifices located in the jet passageways forming relatively high velocity streams directed to engage the bottom of the well bore between the cutting members of the bit. A plurality of cooling passageways extend from the central recess to a point adjacent the bearings of the bit for the purpose of cooling the bearings.

With the regular type bit, the problem of plugging the cooling passageways seems to have been alleviated by positioning a one-way valve in the central opening relatively below the intersection between the cooling passageways and the main air passageway, that is, the central

2

opening. Such an arrangement is illustrated in United States Patent No. 3,268,018 issued to W. J. Neilson on August 23, 1966. While the valve illustrated in the Neilson patent appears to have been a generally satisfactory solution to the plugging problem when regular bits are used in air drilling, no satisfactory solution has been found for eliminating the problem as applied to the more complex passageway system of the jet bits.

Therefore, this invention provides an improved jet type bit, constructed as previously described, that also includes flow control means located in the upper portion of the recess relatively above the intersections of the jet passageways with the chamber, the flow control means including means for substantially preventing flow from the jet passageways therethrough while permitting flow in the opposite direction; and, a hollow member located in the recess and extending through the flow control means, the hollow member having an open lower end located in the lower end of the recess in communication with the cooling passageways and having a perforated upper end portion disposed above the flow control means.

One object of the invention is to provide an improved flow control valve for use in jet type bits.

Another object of the invention is to provide an improved jet type bit for use in air drilling including means for preventing the plugging of the cooling passageways in the bit.

A further object of the invention is to provide an improved flow control means for jet type bits that may be quickly and easily installed and removed from such bits.

Still another object of the invention is to provide an improved flow control valve that can be quickly, easily and economically manufactured.

The foregoing and additional objects and advantages of the invention will become more apparent as the following detailed description is read in conjunction with the accompanying drawings wherein like reference characters denote like parts in all views and wherein:

FIGURE 1 is a bottom elevation view of a jet type bit;

FIGURE 2 is an enlarged, vertical cross-section of the jet type bit of FIGURE 1 taken substantially along the line 2—2 of FIGURE 1 and illustrating flow control means constructed in accordance with the invention located therein; and,

FIGURE 3 is an enlarged, exploded pictorial view illustrating the structure of the flow control means.

Referring to the drawings and to FIGURES 1 and 2 in particular, shown therein and generally designated by the reference character 10 is a jet type bit constructed in accordance with the invention. The bit 10 includes a body 12 and a plurality of cutters 14 journaled on the body 12.

As may be seen in FIGURE 2, the body 12 is threaded at 16 for connection with the lower end of a drill string (not shown). The body 12 also includes a depending arm 18 for each of the cutters 14.

Each of the arms 18 is provided with a spindle 20 that projects therefrom into a recess 22 formed in each of the cutters 14. The cutters 14 are journaled on the spindles 20 by roller bearings 24, ball bearings 26, and other suitable load bearing surfaces such as the button 28.

The body 12 includes a centrally located recess 30 that is divided into an upper chamber 32 and a lower chamber 34. A plurality of jet passageways 36 extending downwardly through the body 12 intersect the upper chamber 32. As shown most clearly in FIGURE 1, the lower ends of the jet passageways 36 are located between adjacent cutters 14.

Located in the lower end of each of the jet passageways 36 is an orifice member 38. It will be noted that the orifice members 38 are provided with a small opening or

3

orifice 40 so that the velocity of the fluid flowing through the passageways 36 is increased. Each orifice member 38 is retained in a respective one of the passageways 36 by a lock member 42. An O-ring seal 44 encircles each orifice member 38 forming a fluid tight seal between each orifice member 38 and the body 12.

A plurality of cooling passageways 46 extend through the body 12 intersecting the lower chamber 34 and terminating adjacent the various bearing surfaces on the spindle 20. The cooling passageways 46 are provided to direct a portion of the air or gas utilized in the drilling process into the bearing surfaces for the purpose of cooling the bearings.

The body 12 has an upwardly facing shoulder 48 encircling the recess 30 in the upper chamber 32. An annular groove 50 also encircles the recess 30, but above the shoulder 48 and in spaced relation thereto.

A centrally located hollow member 52 has its lower end disposed in the lower chamber 34 and has an interior 54 in communication with the cooling passageways 46 through the lower chamber 34. The lower end of the hollow member 52 is preferably in substantial sealing engagement with the body 12. The upper end of the hollow member 52 is provided with a perforated cap 56, thus providing a screen to prevent the entrance of relatively large particles into the interior 54 of the hollow member 52.

A flow control assembly, generally designated by the reference character 58, is located in the recess 30 of the bit body 12 and is retained therein by a lock ring 60 that is disposed in the annular groove 50. The control assembly 58 includes a perforated member 62 that is connected with the hollow member 52 between the cap 56 and the lower end thereof. As clearly shown in FIGURES 2 and 3, the perforated member 62 is frusto-conical in configuration having its inner periphery attached to the hollow member 52 and having its outer periphery disposed in engagement with the lock ring 60. In the preferred form of the invention, the outer periphery of the perforated member 62 is disposed relatively above the inner periphery thereof.

A resilient member 64, which is also frusto-conical in configuration, is disposed in juxtaposition with the lower surface of the perforated member 62. The outer periphery of the resilient member 64 is disposed in engagement with the annular shoulder 48 and the body 12. If desired, the outer peripheries of the perforated member 62 and the resilient member 64 may be connected by a separate member (not shown) prior to the insertion of the control assembly 58 and hollow member 52 into the recess 30.

As shown more clearly in FIGURE 3, the resilient member 64 includes a plurality of circumferentially spaced lacerations 66 that extend radially from the inner periphery toward the outer periphery thereof. The lacerations 66 form a plurality of the leaves 68 that are relatively easily deformed or moved away from the perforated member 62, as illustrated in dash lines in FIGURE 2, by fluid flowing downwardly through the recess 30 in the bit 10. It should also be pointed out that the leaves 68 are returned into engagement with the lower surface of the perforated member 62 substantially closing the perforations therein due to the resiliency of the member 64 and due to flow of fluid upwardly into the recess 30. While it is preferred that the resilient member 64 completely close all the perforations in the perforated member 62, the desired result is obtained from the control assembly 58 even though only a substantial closure of the perforations is actually attained.

Operation

After the flow control assembly 58 and hollow member 52 are assembled, they are inserted into the recess 30 in the body 12 until the resilient member 64 engages the upwardly facing shoulder 48. The lock ring 60 is then inserted to secure the control assembly 58 and the hol-

4

low member 52 in the body 12 as illustrated in FIGURE 2. The bit 10 is then connected by means of the threads 16 with the lower end of a drill string (not shown).

The bit and drill string are lowered into the well bore (not shown) and rotated therein through the drill string forcing the cutters 14 into cutting engagement with the bottom of the well bore. Simultaneously, drilling fluid, in this case air, is circulated downwardly through the drill string into the recess 30. The air then passes through the interior 54 of the hollow member 52 into the cooling passageways 46 to the various bearings journalling the cutters 14 on the spindles 20.

It should be emphasized that the central location of the hollow member 52 places it in the center of the air stream wherein the air velocity is at a maximum. Such a location assures that the bearings will receive the optimum quantity of cooling air.

Also, a portion of the air passes through the perforations in the perforated member 62 into the jet passageways 36, deforming the leaves 68 of the resilient member 64 downwardly as shown in dash lines in FIGURE 2. The air exiting from the jet passageways 36 passes through the orifices 40 and is directed thereby into engagement with the bottom of the well bore. The circulating air then entrains a portion of the cuttings from the well bore and carries them upwardly between the wall of the well bore and the exterior of the bit 10 and drill string (not shown).

If a water bearing formation has been encountered during the drilling of the well bore, the water migrates into the well bore when the circulation of the air ceases. When this occurs, the water rises in the well bore and passes upwardly through the orifices 40 and the jet passageways 36 into the upper chamber 32 of the recess 30. If the leaves 68 sealingly engage the perforated member 62, the water cannot pass the flow control assembly 58. In the event that some leakage occurs, the closure is sufficient to prevent the movement of any relatively large particles through the perforated member 62 so that only very fine particles entrained in the water rise above the control assembly 58. Also, some leakage into the lower chamber 34 between the upper chamber 32 and the lower end of the hollow member 52 will not inhibit the operation of the apparatus since the fit is sufficiently close to prevent the movement therethrough of particles of a size large enough to plug the cooling passageways 46.

Simultaneously, some water may migrate through the journals of the cutters 14, passing upwardly through the cooling passageways 46 into the interior 54 of the hollow member 52. Due to the relatively small space involved, particularly through the bearing surfaces, it is doubtful that any particles of a size sufficient to plug the cooling passageways 46 can pass therethrough.

When drilling is resumed, that is, when circulation of the air is resumed, it passes downwardly through the bit 10 as previously described and forces the water and any particles through the jet passageways 36 and the orifices 40. Since no particles of a size sufficient to plug the cooling passageways 46 can pass into the drill string or the recess 30 above the control assembly 58, the air passing through the interior 54 of the hollow member 52 flushes the water from the cooling passageways 46 assuring the free flow of air therethrough so that the various bearings are cooled, preventing their overheating and galling or otherwise destroying the effectiveness of the bit 10.

The particular construction illustrated, that is, the inverted truncated cone configuration of the perforated member 62 with the cap 56 extending thereabove provides sufficient space to accommodate rust or other particles that may become lodged therein above the perforated member 62. Thus, air will pass freely through the perforations in the cap 56 into the cooling passageways 46. Even though some accumulation of particles or other materials may occur during drilling, the flow of air to the various

5

bearings will not be inhibited and thus will not interfere with the proper operation of the bit 10.

From the foregoing detailed description of the construction and operation of the bit 10, it can be appreciated that there is provided an improved jet type bit useful in connection with air drilling that will effectively prevent plugging of the cooling passageways. Also, it should be apparent that there is provided an effective flow control means for use in a jet type bit that can be quickly and easily installed and removed from the bit 10 and that can be quickly, easily and economically manufactured.

Having described but a single embodiment of the invention, it will be understood that it is presented by way of example only and that many changes and modifications can be made thereto without departing from the spirit of the invention or from the scope of the annexed claims.

What I claim is:

1. In a drill bit having a body, a plurality of cutter means journaled on said body, a recess in said body forming upper and lower chambers, a plurality of jet passageways extending therethrough intersecting said upper chamber and oriented to direct a jet of air between adjacent cutter means, and a cooling passageway extending therethrough for each of said cutter means intersecting said lower chamber and arranged to discharge air into the journals for said cutter means, the improvement comprising:

flow control means located in the upper chamber of said recess relatively above the intersections of said jet passageways with said upper chamber, said flow control means including means for substantially preventing flow from said jet passageways therethrough while permitting flow in the opposite direction; and

a hollow member located in said recess and extending through said flow control means, said hollow member having an open lower end located in said lower chamber in communication with said cooling passageways and a perforated upper end portion above said flow control means.

2. In the bit of claim 1 wherein said flow control means includes:

a perforate member having its inner periphery connected with said tubular member intermediate the ends of said tubular member below said perforated end portion and its outer periphery in engagement with said bit body; and

a resilient member disposed in juxtaposition with said perforate member and movable relatively away from said perforate member to permit flow therethrough and movable toward said perforate member to substantially prevent flow therethrough.

3. In the bit of claim 2 wherein said perforate member and resilient member are frusto-conical in configuration with the inner peripheries thereof being disposed relatively below said outer peripheries.

4. In the bit of claim 2 wherein said resilient member has its outer periphery restrained and has a plurality of spaced lacerations extending substantially radially from the inner periphery thereof toward the outer periphery thereof.

5. In a drill bit having a body, a plurality of cutter means journaled on said body, a recess in said body forming upper and lower chambers, a plurality of jet passageways extending therethrough intersecting said upper chamber and oriented to direct a jet of air between adjacent cutter means, and a cooling passageway extending therethrough for each of said cutter means intersecting said lower chamber and arranged to discharge air into the journals for said cutter means, the improvement comprising:

a hollow member disposed substantially coaxially in said recess and having an open lower end located in said lower chamber in substantial sealing engagement with said body providing communication be-

6

tween the interior of said hollow member and said cooling passageways, said hollow member having its upper end perforated forming a screen;

a perforate member of frusto-conical configuration located in said upper chamber encircling said hollow member, said perforate member having its inner periphery connected with said hollow member relatively below said screen and having its outer periphery disposed relatively above said inner periphery in engagement with said body in the upper chamber and above the intersections of said jet passageways with said upper chamber;

a resilient member disposed in juxtaposition with said perforate member and having its outer peripheral portion retained in engagement with said perforate member, said resilient member having a plurality of lacerations extending substantially radially from its inner periphery toward its outer periphery and being movable away from said perforate member to permit flow therethrough into said jet passageways and movable toward said perforate member to substantially prevent flow from said jet passageways therethrough; and

retainer means engaging the outer periphery of said perforate member and said body to retain said hollow member, perforate member, and resilient member in said body.

6. A drill bit comprising:

a plurality of rotatable cutters;

a bit body including:

a plurality of depending arms each having a journal for rotatably supporting said cutters,

a centrally located recess forming an upper and a lower chamber therein,

a plurality of jet passageways extending through said body intersecting said upper chamber and arranged to discharge air between adjacent cutters, and

a plurality of cooling passageways extending through said journal and intersecting said lower chamber to discharge air into said journals;

flow control means located in the upper chamber of said recess relatively above the intersections of said jet passageways with said upper chamber, said flow control means substantially preventing flow from said jet passageways therethrough while permitting flow in the opposite direction; and

a hollow member located in said recess and extending through said flow control means, said hollow member having an open lower end located in said lower chamber in communication with said cooling passageways and a perforated upper end portion above said flow control means.

7. The bit of claim 6 wherein said flow control means includes:

a perforate member of frusto-conical configuration having its inner periphery connected with said hollow member relatively below said perforated end portion and its outer periphery in engagement with said body in the upper chamber above the intersections of said jet passageways with said upper chamber; and

a resilient member disposed in juxtaposition with said perforate member and having a plurality of substantially radially extending lacerations therein, said resilient member having a portion movable relatively away from said perforate member to permit flow therethrough into said jet passageways and movable toward said perforate member to substantially prevent flow in the opposite direction.

8. The bit of claim 7 wherein:

said body also has an upwardly facing annular shoulder in said upper chamber supporting the outer peripheries of said perforate member and resilient member and an annular groove located above said shoulder;

7

said resilient member has its outer peripheral portion connected with the outer periphery of said perforate member and said lacerations intersect the inner periphery of said resilient member;
said perforate member has its outer periphery disposed 5 above its inner periphery; and
said bit also includes retaining means located in said groove and engaging said perforate member to retain said flow control means and hollow member in said body.

5

10

8

References Cited				
UNITED STATES PATENTS				
1,816,203	7/1931	Behnke	-----	175—337
2,293,259	8/1942	Johnson	-----	175—318
2,293,259	8/1942	Johson	-----	175—318
3,125,175	3/1964	Medlock et al.	-----	175—337
3,268,018	8/1966	Neilson	-----	175—318

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