

[54] **ROCK BIT WATER DEFLECTOR AND SEPARATOR**

[75] Inventor: **Theodore R. Dysart**, Dallas, Tex.

[73] Assignee: **Dresser Industries, Inc.**, Dallas, Tex.

[22] Filed: **Apr. 20, 1970**

[21] Appl. No.: **29,980**

[52] U.S. Cl. **175/337**

[51] Int. Cl. **E21b 9/08**

[58] Field of Search. **175/337, 69**

[56] **References Cited**

UNITED STATES PATENTS

3,198,267	8/1965	Madson	175/337 X
2,329,745	9/1943	Crook	175/337

3,401,758	9/1968	Talbert	175/337 X
3,094,175	6/1963	Jackson	175/69
2,920,872	1/1960	Baur et al.	175/69 X
3,105,563	10/1963	Havenaar	175/337

Primary Examiner—David H. Brown

Attorney, Agent, or Firm—Eddie E. Scott; John N. Hazelwood

[57] **ABSTRACT**

A rotary bit with passageways for conducting air or other gaseous fluid to cool the bearings and flush cuttings from the borehole includes means for separating liquid from the air or gas. The stream of air is directed through a system of baffles to insure that only dry air reaches the bearings.

2 Claims, 5 Drawing Figures

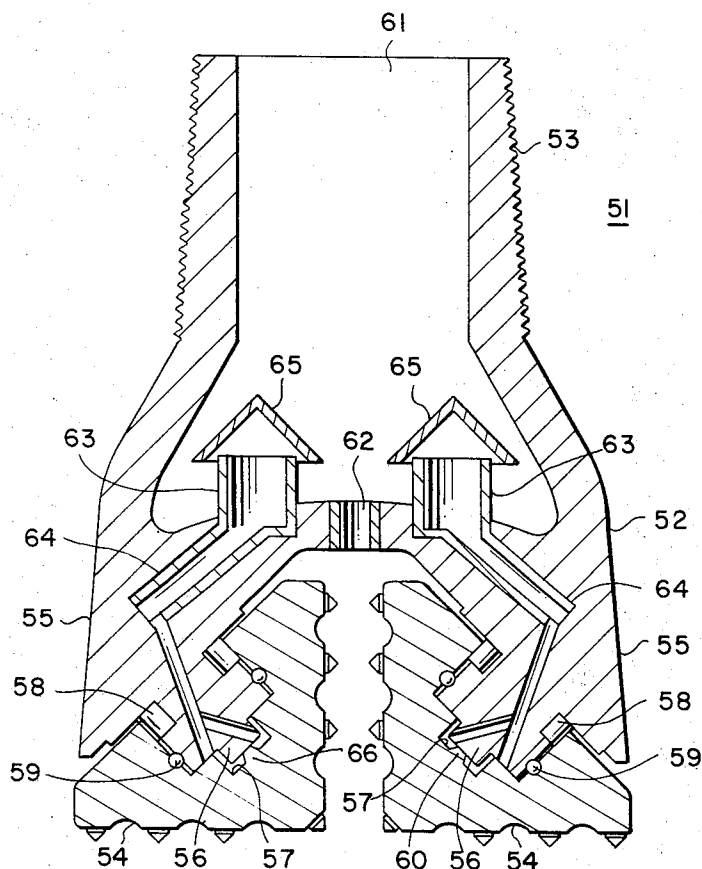


FIG. 1

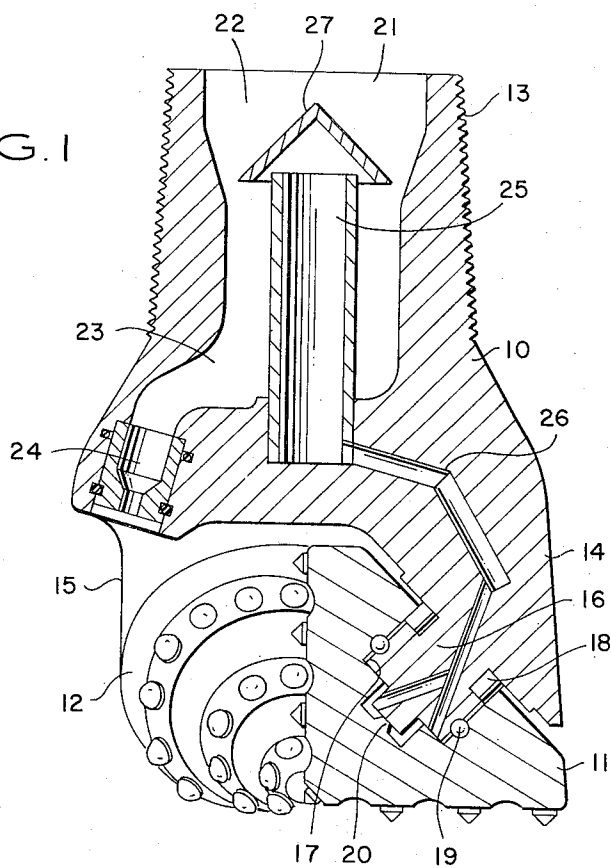
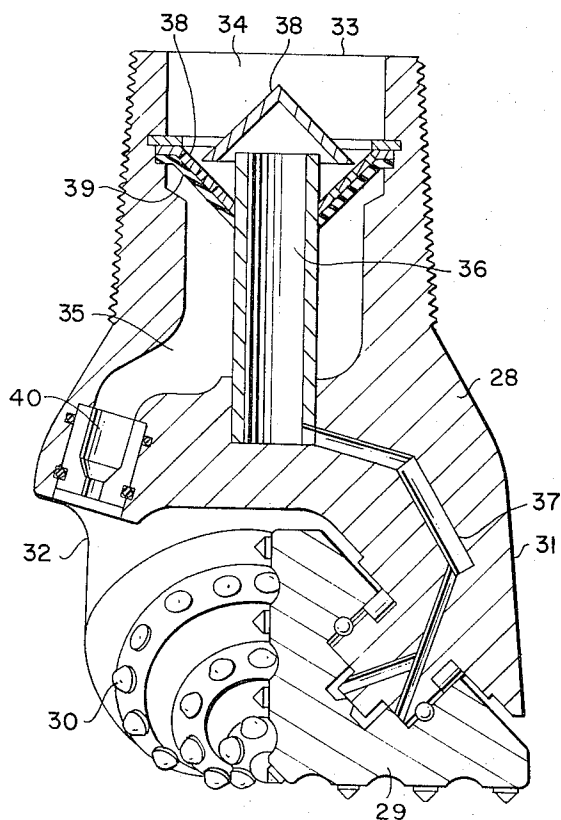


FIG. 2



INVENTOR
THEODORE R. DYSART

Eddie P. Scott
ATTORNEY

FIG. 3

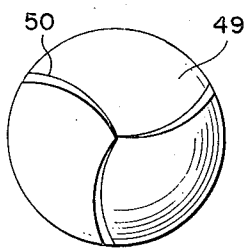
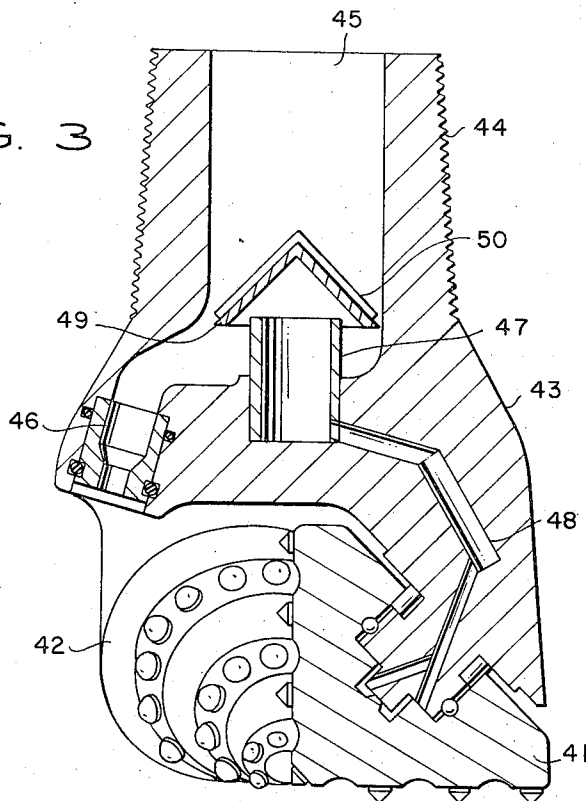
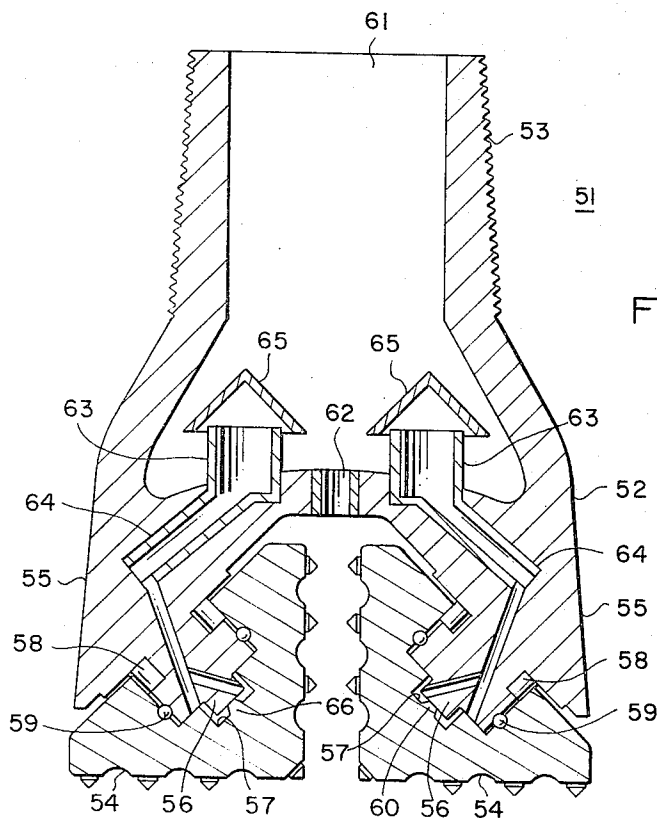


FIG. 4

FIG. 5



INVENTOR
THEODORE R. DYSART

Edith P. Scott

ATTORNEY

ROCK BIT WATER DEFLECTOR AND SEPARATOR

BACKGROUND OF THE INVENTION

This invention relates to the art of rotary drilling and more particularly to a deflector and separator located in a rotary drilling bit. This invention is generally used to drill mining and blast holes, oil and gas wells and the like by the rotary drilling method.

In the drilling of earth bores by the rotary method, air or other gaseous fluid is used as the medium for cooling the bit and for carrying cuttings from the bottom of the hole or well bore to the surface. The fluid is displaced downwardly through the interior of a rotary drill string to the drill bit. The fluid passes through the drill bit and then upwardly through the annular space between the drill string and the wall of the well bore carrying with it the drill cuttings. A relatively large volume of fluid is generally required in the drilling operation. A large portion of the cuttings are in the form of finely divided particles which result in a large amount of dust being released at the drilling site as the fluid is exhausted into the atmosphere. This creates a highly undesirable condition at the drilling site. The drilling equipment may be damaged by the accumulation of dust and the operating personnel are subjected to a health hazard. In addition, the dust is a form of air pollution that should be controlled and may well be intolerable in many circumstances.

A simple solution to the problem would be to add a small amount of water or other liquid to the fluid in order to moisten the surfaces of the cuttings and thereby eliminate the dust. This solution has not been successful prior to the present invention because the liquid introduced to the bit has a damaging effect on the bearings. As previously explained, the bit must be constantly subjected to the circulating fluid in order to cool the bearings and prevent overheating and liquids entrained in the circulating fluid may result in damage to the bearings unless they are prevented from reaching the bearings.

DESCRIPTION OF THE PRIOR ART

A bit that is cooled by directing air or other gaseous fluid through the antifriction bearings is shown in U. S. Pat. No. 3,268,018 to W. J. Neilson, patented Aug. 23, 1966. This patent points out the importance of preventing moisture from accumulating in the bearing.

In U. S. Pat. No. 2,920,872 to G. W. Baur et al., patented Jan. 12, 1960, a system is shown wherein water is introduced to the flushing fluid. The problem solved by this invention relates to the moistened cuttings accumulating on the wall of the borehole near the bit resulting in destructive abrasive action upon the bit.

In U. S. Pat. No. 3,401,758 to M. L. Talbert, patented Sept. 17, 1968, a flow control valve is shown for a jet type bit. A portion of the circulating air is diverted to cool the bearings and the remaining portion of the circulating air is directed to flush the cuttings from the borehole.

SUMMARY OF THE INVENTION

The present invention provides a bit that includes means to separate entrained water or other liquids from the cooling and flushing fluid that is circulated through the bit. This allows a portion of the circulating fluid to be diverted to the bearings with said portion of circulat-

ing fluid including very little, if any, liquid. The remaining portion of the circulating fluid may include sufficient dust suppressing liquid to prevent dust from being exhausted at the drill site.

It is therefore an object of the present invention to provide a drilling system that eliminates dust from the circulating drilling fluid that is exhausted into the atmosphere.

It is a further object of the present invention to provide an earth boring bit that includes means to separate water from the circulating fluid and to conduct the dry air to the bit bearings.

It is a still further object of the present invention to provide a compact earth boring bit that includes means to separate liquids from the circulating fluid.

It is a still further object of the present invention to provide an earth boring bit that deflects and separates water from the circulating fluid without the necessity of having a large cumbersome and costly assembly above the bit.

It is a still further object of the present invention to provide an earth boring bit that effects water separation inside the bit body.

It is a still further object of the present invention to provide a simple and inexpensive way to separate water from the circulating drilling fluid.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a cut away view of a jet type bit including one embodiment of the present invention.

FIG. 2 is another embodiment of the bit of this invention.

FIG. 3 is another embodiment of this invention.

FIG. 4 is a top view of the baffle element of the bit shown in FIG. 3.

FIG. 5 is an embodiment of this invention including a multiplicity of baffle elements inside a rotary bit.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to FIG. 1, a jet type bit is shown constructed in accordance with the invention. The bit includes a body 10 and a plurality of cutters 11 and 12 journaled on the body 10. The body 10 is threaded at 13 for connection with the lower end of a drill string (not shown). The body 10 also includes depending arms 14 and 15 for each of the cutters 11 and 12 respectively.

Each of the arms 14 and 15 supports a rolling cutter for disintegrating the formations as the bit is rotated and moved downward. A bearing means allows the cutters to rotate freely on the individual supporting arms. For example, arm 14 is provided with a spindle 16 that projects therefrom into a recess 17 formed in cutter 11. Cutter 11 is journaled on the spindle 16 by roller bearings 18, ball bearings 19 and other suitable load bearing surfaces such as the button 20.

The body 10 includes a centrally located recess 21 that is divided into an upper chamber 22 and a lower chamber 23. At least one jet passageway 24 extends downwardly through the body 10 from lower chamber 23. The lower ends of the jet passageways are generally located between adjacent cutters.

A plurality of passageways extend through the body 10 to conduct cooling fluid to the bearing surfaces. A central passage 25 extends from upper chamber 22 downwardly in the body of bit 10. One of the multiple passages 26 extends from central passage 25 and termi-

nates adjacent the various bearing surfaces on the spindle 16. The passage 26 is provided to direct a portion of the air or other gaseous fluid utilized in the drilling process into the bearing surfaces for the purpose of cooling the bearings.

A baffle element 27 is positioned over the opening of central passageway 25. This baffle element 27 insures that the gaseous fluid entering central passage 25 will be required to turn the corner and change direction for a short interval before entering the central passage 25. Because the entrained liquid is heavier than the circulating fluid, the liquid will continue into lower chamber 23 to eventually be expelled into the borehole through jet passage 24.

The baffle element 27 is intended to deflect the circulating stream of fluid which at this point consists of the gaseous media along with the injected dust suppressing liquid entrained with the gas. The deflection imparted to the circulating fluid stream separates the liquid from the gaseous portion by diverting the stream to the sides away from central passage 25 and forcing the fluid to change directions before it can enter the interior area of central passageway 25. Because of the differences in densities of the liquid as compared to the gaseous portion of the circulating fluid, the heavier of the two will not undergo a change of direction but will continue into lower chamber 23. The lighter portion of the fluid consisting solely of gaseous fluid will be forced to change direction and enter in a dry state the central passage 25 and be transmitted to bearing surfaces.

Referring now to FIG. 2, another embodiment of the present invention is shown. The bit includes a body 28 and a plurality of individual rolling cutters 29 and 30. The cutters 29 and 30 are journaled on supporting arms 31 and 32 by suitable bearing means.

The bit body 28 includes a central recess 33 divided into upper chamber 34 and a lower chamber 35. A hollow central element 36 forms a passageway wherein the circulating fluid may be channeled to the bearing surfaces by a plurality of individual passageways 37. Positioned over central hollow element 36 is a baffle element 38. This baffle element insures that the circulating fluid will be required to change directions before entering hollow element 36 and subsequent transmission to the bearings. This insures that the fluid reaching the bearing will be free from any dust suppressing liquid entrained with the gas.

A flow control assembly is located between upper chamber 34 and lower chamber 35 to prevent any liquid in the borehole from backing up in the bit and entering the bearings. This flow control assembly includes a perforated member 38 that is frusto-conical in configuration having its inner periphery attached to the hollow element 36 and its outer periphery in engagement with the bit body 28. A resilient member 39 which is also frusto-conical in configuration is disposed in juxtaposition with the lower surface of the perforated member 38. The outer periphery of resilient member 39 is attached to the bit body 28 whereas the inner periphery is unattached. This allows the resilient member to deflect in one direction to allow fluid to pass.

During the drilling operation, it may be necessary to stop the fluid circulation for a period of time. If the bit is surrounded by water or other liquid, the water or liquid may flow upwardly through the drill bit and into the interior of the drill string. This would be highly undesirable because the liquid would enter the bearings. In ad-

dition, any loose cuttings formed during the drilling operation might be carried into the bit. The flow control assembly prevents flow upward from lower chamber 35 into the bit. However, the flow control assembly does allow the circulating fluid to flow from upper chamber 34 into lower chamber 35 and eventually be expelled into the borehole through the jet passage 40.

Referring now to FIGS. 3 and 4, another embodiment of the bit of this invention is shown. A plurality of rolling cutters 41 and 42 are shown mounted on individual arms extending from the main bit body 43. The bit body 43 is threaded at 44 for connection with the lower end of the drill string.

The bit body 43 includes a central recess 45 to allow the circulating fluid to enter the bit. A plurality of jet passageways such as the jet passageway 46 are provided in communication with the recess 45 to allow the circulating fluid to enter the borehole in proximity to the rolling cutters. A central hollow element 47 forms part of a passageway system 48 to direct a portion of the circulating fluid into contact with the bearing surfaces of each cutter for the purpose of cooling the bearings. Positioned over the hollow element 47 is a baffle member 49. This baffle member deflects the circulating fluid in order to prevent the entrained liquid from reaching the bearings. The baffle element 49 includes a slinger element 50 mounted on the upper surface of element 49. The slinger element 50 will impart additional centrifugal energy to the denser portion of the circulating fluid thereby insuring that all liquid will be removed from the gaseous medium. The slinger element 50 consists of a multiplicity of veins attached to the conical surface of element 49. As the bit is rotated, the veins 50 will impart additional centrifugal energy to the circulating fluid thereby separating the heavier or liquid portion from the lighter gaseous medium.

Referring now to FIG. 5, a partially cut away sectional view of a bit constructed in accordance with this invention is indicated generally at 51. The bit 51 includes a body 52 with a threaded portion 53 for connecting the bit with the lower end of a drill string (not shown). Bits of this character generally include three rolling cutters although a greater or lesser number of cutters may be employed. Two of the three cutters are shown in this view of the bit. Cutters 54 are rotatably attached to individual arms 55 depending from the main bit body 52. Each of the arms 55 is provided with a spindle 56 that projects therefrom into a recess 57 formed in each of the cutters 54. The cutters 54 are journaled on the spindle 56 by roller bearings 58, ball bearings 59, and other suitable load bearing surfaces such as the buttons 60.

The body 52 includes a centrally located recess 61. Located within central recess 61 is at least one passageway 62 that serves as an exit for the circulating fluid. Although a single passageway 62 is shown, it is to be understood that a plurality of passageways may be provided to direct high velocity streams of circulating fluid between the cutting members of the bit.

Also included in central recess 61 are plurality of hollow elements 63. A plurality of cooling passageways 64 extend from hollow elements 63 and terminate adjacent the various bearing surfaces on the spindle 56. The cooling passageways 64 are provided to direct a portion of the air or other gaseous fluid utilized in the drilling process into the bearing surfaces for the purpose of

5

cooling the bearings. In order to insure that only dry air reaches the bearing surfaces, a plurality of baffle elements 65 are provided in recess 61. Each baffle element 65 is positioned over an individual hollow element so that the air or other gaseous fluid entering the hollow elements 63 will be required to turn the corner and change direction for a short interval before entering hollow elements 63 and passageways 64. The liquids entrained in the circulating fluid being heavier than the gaseous portion of the fluid will continue past baffle elements 65 to eventually be expelled into the borehole through passageway 62.

The present invention insures that only dry air will reach the bearings. The bit 51 and drill string (not shown) are lowered into the well bore and rotated therein. The drill string forces the cutters 54 into cutting engagement with the bottom of the well bore. Simultaneously a fluid, generally air, is circulated downwardly through the drill string into the recess 61. In order to prevent dust from the drill cuttings from polluting the air around the drill site as the circulating fluid is exhausted into the atmosphere, a liquid, generally water, is added to the fluid being pumped down the drill string. As the circulating fluid and entrained liquid pass through recess 61 and exit into the borehole through the passageway 62, the heavier liquid will be diverted by baffle elements 65 and not enter hollow elements 63 and passageways 64. This insures that the bearings will remain dry and the life of the bit will be extended.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A drill bit with fluid circulation, comprising:
 - a main body;
 - a plurality of cutter members rotatably attached to said main body;
 - bearing means for reducing friction between said main body and said cutter members;
 - means for separating the fluid into a first portion and a second portion, said first portion including a relatively small amount of water and said second portion including a relatively large amount of water, said means for separating the fluid into a first portion and a second portion including three hollow members and means covering each hollow member for preventing said fluid from directly entering said hollow members; means for directing said first portion of fluid to said bearing means; and means for directing said second portion of fluid proximate said cutter members.
2. A drill bit adapted to be connected to a rotary drill string, wherein a fluid containing an entrained dust suppressing liquid is circulated through said drill string, comprising:
 - a main bit body adapted to be connected to said rotary drill string, said main bit body including a central chamber having an opening for communication with said rotary drill string;

6

- a first cutter member rotatably attached to said main bit body;
- first bearing means for promoting rotation of said cutter member;
- first passage means extending from said central chamber for directing a portion of said fluid to said first bearing means;
- a first hollow element positioned in said central chamber and connected to said first passage means;
- a first cap means positioned over said first hollow element in said central chamber for preventing said circulating fluid from directly entering said first hollow element and causing said fluid to change directions one or more times and substantially preventing said entrained dust suppressing liquid from entering said first hollow element and said first passage means;
- a second cutter member rotatably attached to said main bit body;
- second bearing means for promoting rotation of said second cutter member;
- second passage means extending from central chamber for directing a portion of said fluid to said second bearing means;
- a second hollow element positioned in said central chamber and connected to said second passage means;
- a second cap means positioned over said second hollow element in said central chamber for preventing said circulating fluid from directly entering said second hollow element and causing said fluid to change directions one or more times and substantially preventing said entrained dust suppressing liquid from entering said second hollow element and said second passage means;
- a third cutter member rotatably attached to said main bit body;
- third bearing means for promoting rotation of said third cutting member;
- third passage means extending from said central chamber for directing a portion of said fluid to said third bearing means;
- a third hollow element positioned in said central chamber and connected to said third passage means;
- a third cap means positioned over said third hollow element in said central chamber for preventing said circulating fluid from directly entering said third hollow element and causing said fluid to change direction one or more times and substantially preventing said entrained dust suppressing liquid from entering said third hollow and said third passage means; and
- a fourth passage means extending from said central chamber for directing a fourth portion of said fluid approximate said first, second and third cutter members.

* * * * *

60

65