An earth bit includes an earth bit body having a bore with a bearing passageway in fluid communication therewith. A screen extends through the bore and is repeatably moveable between rolled and unrolled conditions. The screen is in the rolled condition when extending through the bore. The screen screens a material flowing between the bore and bearing passageway.
**FIG. 6**

1. Provide Lugs Coupled together to form an Earth Bit Body with a Bore Extending therethrough
2. Provide a Screen
3. Extend the Screen through the Bore

**FIG. 7**

1. Provide an Earth Bit with a Bore Extending Therethrough
2. Provide a Screen
3. Provide a Shroud Attached to the Screen
4. Extend the Screen through the Bore
EARTH BIT HAVING A SCREEN
CROSS-REFERENCE TO RELATED APPLICATIONS

This patent application claims priority to U.S. Provisional Application No. 60/822,913 filed in Aug. 18, 2006, the contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention
2. Description of the Related Art
3. This invention relates generally to eath boring tools for boring a hole.
4. Earth boring tools are commonly used to bore holes by cutting through earthen annulus. Such holes may be bored for many different reasons, such as drilling for oil, minerals and water. One type of earth boring tool used for boring is a rotary earth bit. Several examples of rotary earth bits are disclosed in U.S. Pat. Nos. 3,550,972, 3,847,235, 4,136,748, 4,427,307, 4,688,651, 4,741,471 and 6,513,607.

A rotary earth bit generally includes three lugs coupled together to form an earth bit body having a bore extending therethrough. A cutting cone is rotatably mounted to each lug with a journal, which includes ball and roller bearings. The lug rotates in response to the rotation of the earth bit. The cutting cones are engaged with the roller and ball bearings and rotate about the journal in response to contacting earthen annulus.

A drilling fluid, such as water and/or air, typically flows through the bore. A portion of the drilling fluid is flowed through a nozzle to spray material, such as earthen annulus, away from the cutting cone. Another portion of the drilling fluid is flowed through a bearing passageway and towards the cutting cone and journal. The portion of the drilling fluid flowed through the bearing passageway is used to cool the cutting cone and journal, as well as the lubricating material. In this way, the earth bit operates at a lower temperature. However, it is desirable to control the flow of material through the bearing and nozzle passageways.

BRIEF SUMMARY OF THE INVENTION

The present invention employs a screen for use with an earth bit. The earth bit includes an earth bit body having a bore with bearing and nozzle passageways in fluid communication therewith. The screen is biased against the earth bit body when extending through the bore. The screen extends through the bore and between the nozzle and bearing passageways and screens a material flowing between the bore and bearing and nozzle passageways. The material is generally drilling fluid which includes water and air.

In some embodiments, a shroud is positioned to divert the flow of the material between the bore and bearing passageway. The flow of the material is diverted to reduce the amount of water that enters into the bearing passageway. In this way, the shroud is positioned to restrict the flow of the water between the bore and bearing passageway. The shroud is carried by the screen and includes a shroud opening that faces downstream from the fluid flow. The material that flows between the shroud opening and bearing passageway is screened by the screen.

Further features and advantages of the invention will be apparent to those skilled in the art from the following detailed description, taken together with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an earth bit having a screen, in accordance with the invention.
FIG. 2a is a cut-away view of the earth bit of FIG. 1 taken along a cut-line 2-2.
FIG. 2b is a bottom view of the earth bit and screen of FIG. 1, in accordance with the invention.
FIGS. 3a and 3b are perspective views of a screen in unrolled and rolled conditions, respectively.
FIGS. 4a and 4b are end views of the screen of FIG. 3b in the rolled condition.
FIG. 5a is a perspective view of a shroud, in accordance with the invention.
FIG. 5b is a partial cut-away view of a region of the earth bit of FIG. 2a showing the shroud of FIG. 5a being carried by the screen.
FIGS. 6 and 7 are flow diagrams of methods of assembly an earth bit with a screen, in accordance with the invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 is a perspective view of an earth bit having a screen, in accordance with the invention. FIG. 2a is a cut-away view of earth bit 100 taken along a cut-line 2-2 of FIG. 1, showing a bore 110 and screen 112. FIG. 2b is a view of screen 112 and bore 110 looking in a direction 128 of FIG. 2a. Earth bit 100 includes several earth bit components assembled together. In this embodiment, these components include three lugs 102 coupled together to form an earth bit body 101 having a bore 110 (FIG. 2a) extending thereethrough. In this particular embodiment, earth bit 100 includes three cutting cones 103 rotatably mounted to corresponding lugs 102 with journals 104, so that earth bit 100 is a tri-cone earth bit. Journal 104 includes ball and roller bearings 106 and 107, respectively, which engage cutting cone 103 so that cutting cone 103 is rotatably mounted thereto.

In this embodiment, bore 110 is in fluid communication with a bearing passageway 108 and a nozzle passageway 111. Bore 110 is in fluid communication with bearing passageway 108 and nozzle passageway 111 through openings 110a and 110b, respectively. Bearing passageway 108 extends through earth bit body 101 and between bore 110 and journal 104. Nozzle passageway 111 extends through earth bit body 101 and between bore 110 and a nozzle 105. It should be noted that earth bit 100 generally includes one bearing passageway for each lug it includes. Further, earth bit 100 generally includes one nozzle and nozzle passageway for each cutting cone it includes, wherein the nozzle is directed at a corresponding cutting cone.

In operation, lug 102 rotates in response to the rotation of earth bit 100. Cutting cone 103 is engaged with ball and roller bearings 106 and 107 and rotates, in response to contacting earthen annulus, about journal 104. A drilling fluid, such as water and/or air, is often flowed through bore 110. A portion of the drilling fluid is flowed through nozzle passageway 111 and nozzle 105 to spray material, such as...
earthen annulus, away from cutting cone 103. Earth bit 100 operates more efficiently if material is sprayed away from cutting cone 103 with drilling fluid.

[0021] Another portion of the drilling fluid is flowed through bearing passageway 108 and towards cutting cone 103 and journal 104. The portion of the drilling fluid flowed through bearing passageway 108 is used to reduce the temperature of cutting cone 103 and journal 104. In this way, earth bit 100 operates at a lower temperature. However, it is desirable to control the flow of material through bearing passageway 108 and nozzle passageway 111.

[0022] In accordance with the invention, screen 112 is positioned in bore 110 to cover openings 110a and 110b, as indicated by a substitute arrow 129 in FIG. 2a. Screen 112 is repeatedly moveable between positions where it is away from bore 110 and where it extends through bore 110. Screen 112 can be made of many different materials, such as metal. The material included with screen 112 is chosen so that screen 112 is flexible and it can be repeatedly moved between rolled and unrolled conditions.

[0023] When in the rolled condition, screen 112 is biased to move to the unrolled condition. In this way, screen 112 applies a force, denoted as force F, to earth bit body 101 when it extends through bore 110 (FIG. 2b). An outer periphery 115 of screen 112 frictionally engages earth bit body 101 in response to force F. It should be noted, however, that screen 112 can be engaged with bore 110 in many other ways, such as by welding or with fasteners.

[0024] Screen 112 extends between openings 110a and 110b and covers them. In this way, screen 112 extends through bore 110 and between bearing passageway 108 and nozzle passageway 111. Screen 110 includes openings which allow the drilling fluid to flow therethrough. However, the openings of screen 110 are shaped and dimensioned to restrict the flow of undesirable material through openings 110a and 110b. The undesirable material can be of many different types, such as abrasive material like earthen annulus.

[0025] FIGS. 3a and 3b are perspective views of screen 112 in unrolled and rolled conditions, respectively. It should be noted that screen 112 is in the rolled condition when extending through bore 110. In this embodiment, screen 112 is a rectangular piece of material with openings extending through it. It should be noted that screen 112 can be of many other shapes, but a rectangular shape is shown here for illustrative purposes. Screen 112 has opposed sides 113a and 113b, as well as opposed sides 113c and 113d. Sides 113a and 113b have a width dimension denoted as \( w_{\text{screen}} \) and sides 113c and 113d have a length dimension denoted as \( l_{\text{screen}} \).

[0026] In the unrolled condition, sides 113a, 113b, 113c, and 113d extend linearly because screen 112 is a rectangular piece of material. Further, in the unrolled condition, sides 113a and 113b are away from each other, and sides 113c and 113d are away from each other. In the rolled condition, sides 113a and 113b are away from each other and sides 113c and 113d are towards each other. It should be noted that sides 113a and 113b curve in response to moving sides 113c and 113d towards each other. Sides 113c and 113d extend linearly and, when they are proximate to each other, sides 113a and 113b define opposed openings 114a and 114b, respectively, wherein openings 114a and 114b have a diameter \( d_{\text{screen}} \).

[0027] FIGS. 4a and 4b are end views of screen 112 in the rolled condition. In this embodiment screen 112 is rolled so it has diameter \( d_{\text{screen}} \). Diameter \( d_{\text{screen}} \) is variable and depends on the dimensions of screen 112 and the amount of overlap between sides 113c and 113d, as indicated by an indication arrow 116 in FIG. 4a. Sides 113c and 113d generally overlap by a distance \( D_{1} \), when they are proximate to each other and are engaged together in a region 117. It should be noted that distance \( D_{1} \) and region 117 increase as the amount of overlap between sides 113c and 113d increases. Further, distance \( D_{1} \) and region 117 decrease as the amount of overlap between sides 113c and 113d decreases.

[0028] When sides 113c and 113d engage each other, but do not overlap, they form an interface 119, as indicated by an indication arrow 118 in FIG. 4b. It should be noted that sides 113c and 113d, as shown in FIGS. 4a and 4b, can be held together, if desired. Sides 113c and 113d can be held together in many different ways, such as with a weld and a fastener.

[0029] FIG. 5a is a perspective view of a shroud 121, in accordance with the invention. In this embodiment, shroud 121 includes an open end 122 and a closed end 123, and opposed sides 126 and 127 which extend therebetween. A shroud opening 124 extends through open end 122 and a shroud channel 125 extends between open and closed ends 122 and 123, as well as opposed sides 126 and 127.

[0030] FIG. 5b is a partial cut-away view of a region 119, as shown in FIG. 2a, of earth bit 100. In this embodiment, shroud 121 is carried by screen 112 within bore 110 and proximate to opening 110a of bearing passageway 108. Shroud 121 is positioned so that open end 122 and closed end 123 are positioned upstream and downstream, respectively, relative to opening 110a. In this way, shroud opening 124 is positioned downstream from opening 110a and bearing passageway 108. It should be noted that screen 112 extends between open and closed ends 122 and 123, as well as opposed sides 126 and 127, so that it extends along shroud channel 125.

[0031] Shroud 121 can be carried by screen 112 in many different ways. For example, it can be fastened to screen 112 using a fastener, weld or an adhesive. In other examples, shroud 121 includes hooks which hook to screen 112. Shroud 121 can be removably attached to screen 112 or it can be attached to screen 112 so it is repeatedly removeable thereof.

[0032] In operation, drilling fluid flows through bore 110 from closed end 123 towards open end 122 of shroud 121. In this example, the drilling fluid includes water and air. The water flows past shroud 121 and a portion of the air is diverted through opening 124, where it flows upstream through channel 125 to opening 110a. The air flows through screen 112 and into opening 110a and bearing passageway 108 to the earth bit component discussed above. In this way, shroud 121 diverts a material flow between bore 110 and bearing passageway 108 and allows a portion of the drilling fluid to flow upstream so it can enter bearing passageway 108.

[0033] The change in direction (i.e. diversion) of the flow of the drilling fluid reduces the amount of water in the air that flows into bearing passageway 108. It is useful to reduce the amount of water that enters into bearing cavity 109 because it increases bearing performance and bit life. The portion of the drilling fluid that does not flow through shroud
opening 124 generally flows through nozzle passageway and nozzle 105, as shown in FIG. 2a.  
[0034] FIG. 6 is a flow diagram of a method 200 of assembling an earth bit, in accordance with the invention. Method 200 includes a step 201 of providing lugs coupled together to form an earth bit body with a bore extending therethrough. A first bearing passageway extends through the lug and is in fluid communication with the bore.

[0035] In a step 202, a screen is provided, wherein the screen is repeatedly moveable between rolled and unrolled conditions. In some embodiments, the screen is provided in the rolled condition and, in other embodiments, the screen is provided in the unrolled condition and moved to the rolled condition.

[0036] In step 202, the screen is extended through the bore so it covers an opening of the first bearing passageway that faces the bore. In some embodiments, when the screen is in the rolled condition, it is biased to move to the unrolled condition. The screen engages the earth bit body in the bore when it extends therethrough and is biased to move to the unrolled condition. In other embodiments, the screen is held in the rolled condition. The screen can be held in the rolled condition in many different ways, such as with a fastener and weld.

[0037] It should be noted that, in some embodiments, a second bearing passageway extends through the lug and is in fluid communication with a nozzle. In these embodiments, the screen covers an opening of the second bearing passageway that faces the bore. The screen extends between the openings of the first and second bearing passageways.

[0038] FIG. 7 is a flow diagram of a method 210 of assembling an earth bit, in accordance with the invention. Method 210 includes a step 211 of providing an earth bit with a bore extending therethrough. In this embodiment, the earth bit includes a lug with a first bearing passageway extending through the lug and in fluid communication with the bore.

[0039] In a step 212, a screen is provided, wherein the screen is repeatedly moveable between rolled and unrolled conditions. In some embodiments, the screen is provided in the rolled condition and, in other embodiments, the screen is provided in the unrolled condition and moved to the rolled condition.

[0040] In a step 213, a shroud is provided and attached to the screen. In a step 214, the screen is extended through the bore so it covers an opening of the first bearing passageway that faces the bore. The screen is positioned so that the shroud is proximate to the first bearing passageway. In some embodiments, when the screen is in the rolled condition, it is biased to move to the unrolled condition. The screen engages the earth bit body in the bore when it extends therethrough and is biased to move to the unrolled condition. In other embodiments, the screen is held in the rolled condition. The screen can be held in the rolled condition in many different ways, such as with a fastener and weld.

[0041] While particular embodiments of the invention have been shown and described, numerous variations and alternate embodiments will occur to those skilled in the art. Accordingly, it is intended that the invention be limited only in terms of the appended claims.

1. An earth bit, comprising:  
an earth bit body having a bore with a bearing passageway  
in fluid communication therewith; and  
a screen extending through the bore, the screen being  
repeatably moveable between rolled and unrolled conditions.

2. The earth bit of claim 1, wherein the screen is in the  
rolled condition when extending through the bore.

3. The earth bit of claim 1, wherein the screen is biased  
against the earth bit body when extending through the bore.

4. The earth bit of claim 1, wherein the screen covers the  
bearing passageway when extending through the bore.

5. The earth bit of claim 1, wherein the screen screens a  
material flowing between the bore and bearing passageway.

6. The earth bit of claim 1, wherein opposed ends of the  
screen are proximate to each other when the screen is in the  
rolled condition.

7. The earth bit of claim 1, further including a shroud  
carried by the screen, the shroud being positioned proximate  
to the bearing passageway.

8. An earth bit, comprising:  
an earth bit body having a bore with nozzle and bearing  
passageways in fluid communication therewith; and  
a screen which extends through the bore and between the  
nozzle and bearing passageways.

9. The earth bit of claim 8, wherein the screen is  
repeatably moveable between rolled and unrolled conditions.

10. The earth bit of claim 8, wherein the screen is in the  
rolled condition when extending between the nozzle and  
bearing passageways.

11. The earth bit of claim 10, wherein the screen is biased  
against the earth bit body when extending between the  
nozzle and bearing passageways.

12. The earth bit of claim 8, wherein the screen screens a  
material flowing between the bore and the nozzle and  
bearing passageways.

13. The earth bit of claim 8, further including a shroud  
positioned to divert a material flow between the bore and  
bearing passageway.

14. The earth bit of claim 13, wherein the shroud is carried  
by the screen.

15. An earth bit, comprising:  
an earth bit body having a bore with a bearing passageway  
in fluid communication therewith;  
a screen which extends through the bore and screens a  
material flowing between the bore and bearing passageway;  
and  
a shroud positioned to restrict the flow of the material  
between the bore and bearing passageway.

16. The earth bit of claim 15, wherein the shroud includes  
a shroud opening that faces downstream from the material  
flow.

17. The earth bit of claim 16, wherein the screen screens  
the material flowing through the shroud.

18. The earth bit of claim 15, wherein the screen covers an  
opening of the bearing passageway that faces the bore.

19. The earth bit of claim 15, wherein the screen is  
repeatably moveable between rolled and unrolled conditions.

20. The earth bit of claim 15, wherein the screen is biased  
against the earth bit body.

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