United States Patent

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[54] **DRILL BIT**
10 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **175/337**
[51] **Int. Cl.** **E21c 13/00**
[50] **Field of Search** 175/337, 227, 228; 308/8.2

[56] **References Cited**

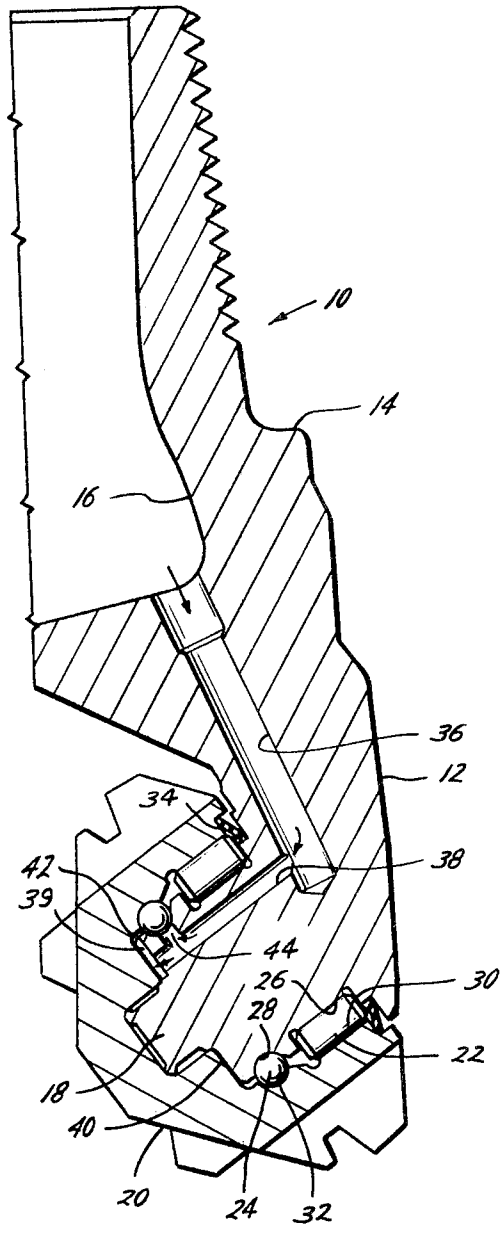
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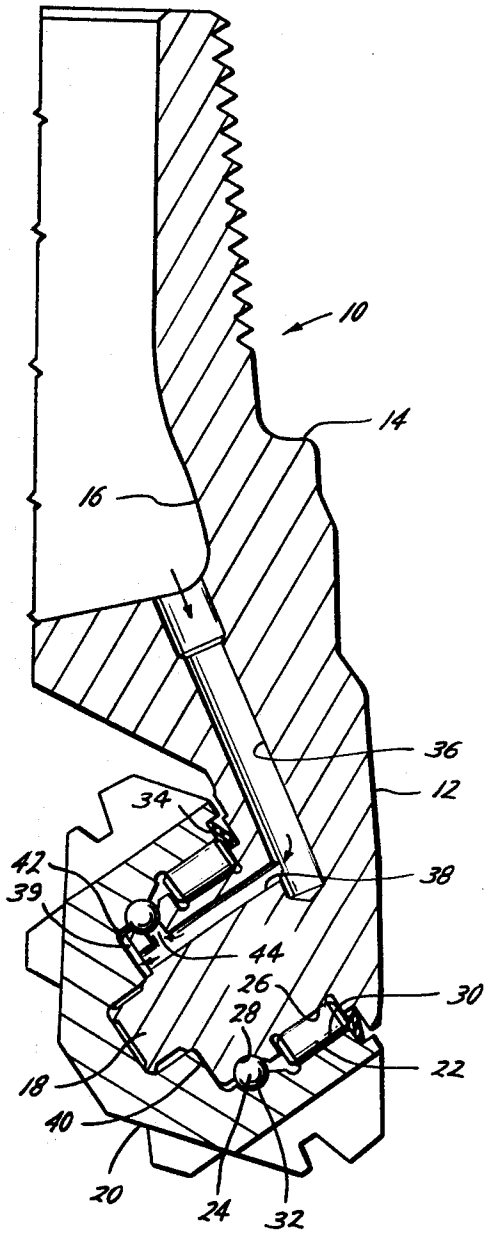
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ABSTRACT: An improved drill bit having a gaseous circulation system for the roller cutters to be used in gas drilling so that a portion of the gas which is circulated through the drill is circulated through the roller cutters to cool the cutter bearings.



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Fig. 1



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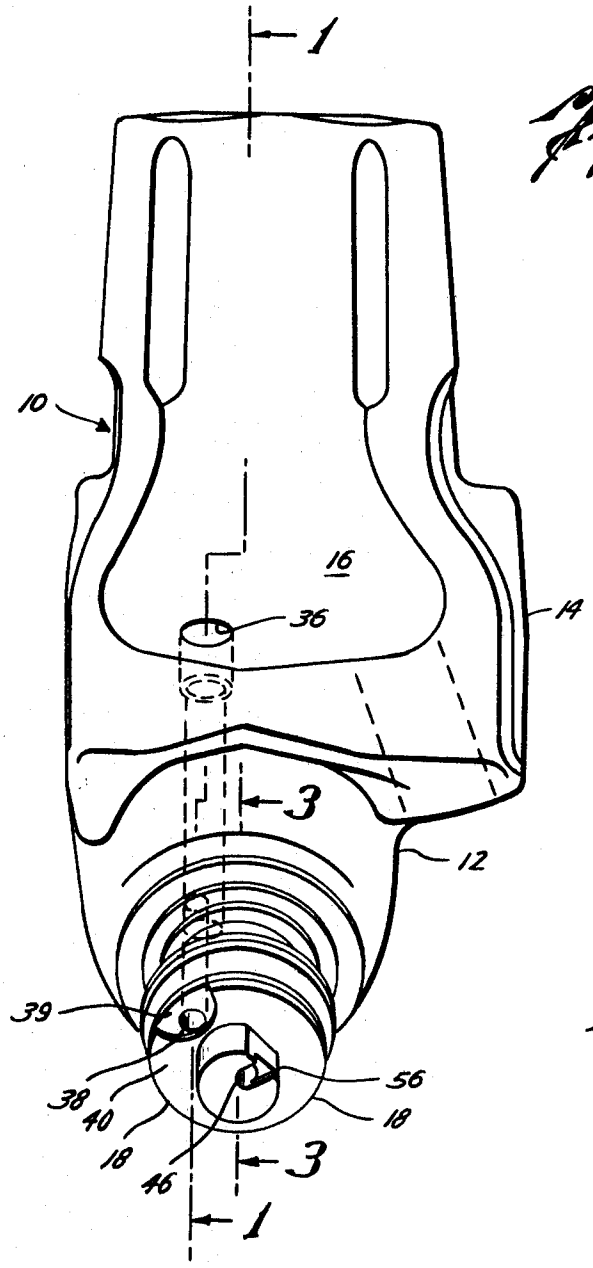


Fig. 2

Fig. 3

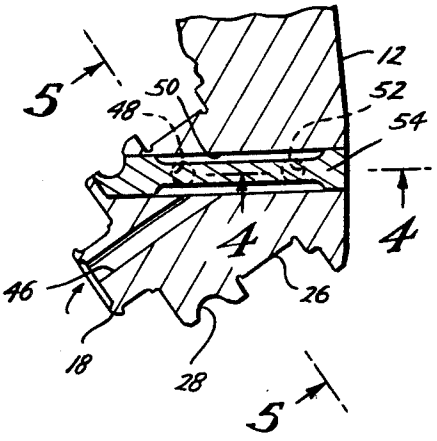
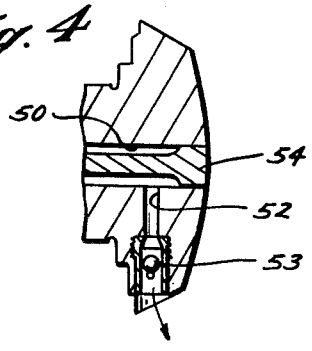


Fig. 4



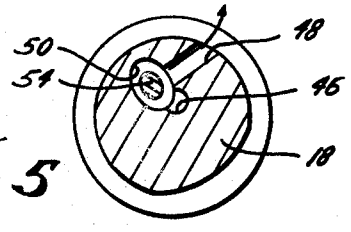


Fig. 5

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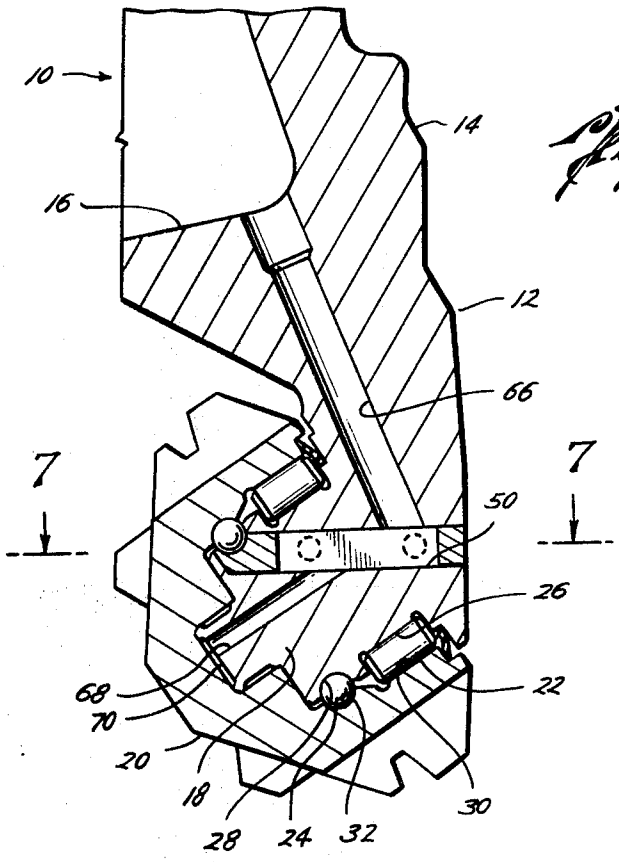


Fig. 6

Fig. 7

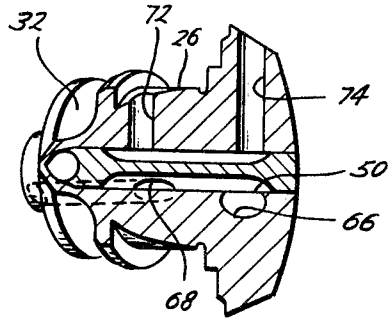
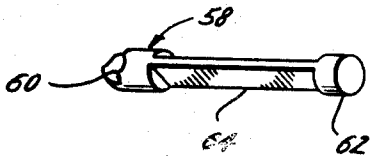


Fig. 8



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DRILL BIT

SUMMARY

The present invention relates to an improved drill bit for use in drilling with a gaseous circulating fluid.

Prior drill bits having air or gas circulation have not had seals but have caused the air circulation to flow through the bearing. With such drill bits, when water is encountered or is injected for dust control, the heavier moist cuttings often are forced into the bearings which results in a relatively short bearing life. Other types of bits having seals are not satisfactory since the seals are exposed and once they are destroyed, the bearings deteriorate rapidly with the entry of the cutting into the bearings.

An object of the present invention is to provide an improved drill bit for use in drilling with air or gas circulation which bit has extended life and improved bit footage.

A further object is to provide an improved roller cutter drill bit with a circulation system to extend the life of the cutter seals.

Still another object is to provide an improved roller cutter drill bit with a circulation system utilizing the ball loading hole and in which gas circulated therethrough cools the roller cutter to extend its bearing life.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of one segment of a drill bit taken along line 1–1 in FIG. 2 to illustrate the inlet passages of the circulation system of the present invention.

FIG. 2 is an internal view of a segment of the improved drill bit of the present invention with the roller cutter removed.

FIG. 3 is a sectional view taken along line 3–3 in FIG. 2 to show a portion of the outlet passages of the circulation system of the present invention.

FIG. 4 is a sectional view taken along line 4–4 in FIG. 3 showing the discharge passage.

FIG. 5 is a sectional view taken along line 5–5 in FIG. 3 showing the relationship of the outlet passages.

FIG. 6 is a sectional view of a drill bit segment illustrating a modified form of circulating system.

FIG. 7 is a sectional view taken along line 7–7 in FIG. 6 showing the passages in the bearing shaft and the discharge passage.

FIG. 8 is a perspective view of the modified ball loading plug shown in FIGS. 6 and 7.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings, the drill bits are shown by showing details of one segment, it being understood that the drill bit will normally have two or more segments. The drill bit segment **10** as shown in FIGS. **1** and **2** includes the leg **12** depending from the head or body **14**. The head **14** defines the internal chamber **16** which during drilling is in communication with the circulating fluid passage in a drill string when the drill bit is connected to the lower end of the drill string for drilling. The leg **12** terminates in the bearing shaft **18**.

The roller cutter **20** is mounted on bearing shaft **18** and the bearing means including the roller bearings **22** and the ball bearings **24** are provided to support the roller cutter **20** for rotation about bearing shaft **18**. From FIG. **1** it can be seen that bearing shaft **18** defines the roller race **26** and the ball race **28** while the cutter **20** defines the mating roller race **30** and the ball race **32**. To prevent the entry of solids between the cutter **20** and the bearing shaft **18** the annular seal **34** is positioned to seal between the open end of cutter **20** and the bearing shaft **18**. As long as seal **34** functions properly, the bearings **22** and **24** are protected from solids.

In order to prolong the life of seal **34** and to cool bearings **22** and **24**, the drilling fluid (gas or air), is circulated through the space between roller cutter **20** and bearing shaft **18**. The inlet passages **36** and **38** are located in leg **12** and bearing shaft **18** as shown and provide communication from chamber **16** to the space between the annular shoulder **40** on bearing shaft **18** and the shoulder **42** defined in cutter **20**. Passage **44** communicates from passage **38** to the bearing race **28**. As best seen in FIG. **2** a portion of shoulder **40** around the opening of passage **38** is removed providing recess **39** to minimize the restriction to the flow of fluid discharged from passage **38**.

The return flow of fluid is directed through passages **46** and **48** into the ball loading hole **50** and is discharged from the drill bit segment **10** through the passage **52** which communicates from the ball loading hole **50** through check valve **53** to the trailing side of leg **12**. As shown in FIGS. **3**, **4** and **5**, the plug **54** is positioned in the ball loading hole **50** to retain the balls in their races. The intermediate portion of plug **54** has a reduced diameter to provide communication from passages **46** and **48** through the ball loading hole **50** to the outlet passage **52** which opens to the exterior trailing side of leg **12** to prevent clogging of the passages. Passage **46** communicates between the recess **56** in the end of bearing shaft **18** to the ball loading hole **50**. Passage **48** communicates from the roller race **26** to the ball loading hole **50**.

The passages shown and described provide for circulation of the gaseous drilling fluid through and over the bearing surfaces to cool the points of rolling and sliding contact between bearing shaft **18** and roller cutter **20**. It has been found that this cooling extends the life of the seal **34** and consequently by preventing entry of solids into the bearings extends the life of the cutter.

In the modified form of the invention illustrated in FIGS. **6**, **7** and **8**, the same type of passages are provided to deliver the air or gaseous drilling fluid to cool the bearings. In this modified form all components which are the same as shown in the other drawings are given the same number.

The ball loading hole **50** in this modified form is used for both an inlet passage and an outlet passage. To accomplish this dual use of the ball loading hole **50**, the special plug **58** is provided. As shown, plug **58** includes the bearing support **60** and the outer cylindrical end **62** joined by the flat arm **64**. Arm **64** has a width which is substantially the diameter of the ball loading hole **50** so that it will seal against the interior of hole **50** or restrict the flow of fluid directly between its inlet and outlet sides.

Inlet passage **66** extends from chamber **16** to the inlet side of loading hole **50**. Passage **68** communicates from the inlet side of hole **50** to the recess **70** in the outer end of bearing shaft **18**. Passage **72** communicates between bearing race **26** and the outlet side of arm **64** in hole **50**. Passage **74** communicates from the outlet side of hole **50** to discharge fluid on the trailing side of drill bit segment **10**.

Fluid from chamber **16** is thus circulated through passage **66**, the inlet side of hole **50** and passage **68** to the end of bearing shaft **18** within cutter **20**. The fluid flows over contact surfaces to cool such surfaces and is discharged through passage **72**, the outlet side of hole **50** and passage **74** to the exterior of the drill bit.

Both forms of the present invention provide for the circulation of a gaseous drilling fluid over the contact surfaces between the roller cutter and the bearing shaft and discharge the fluid therefrom. This fluid flow cools the bearing surfaces to extend the life of the cutter seal, thus extending the life of the cutter. In both forms of the invention, passages are provided to direct fluid to and discharge fluid from the space between the roller cutter and the bearing shaft. The ball loading hole is used as a passage in both forms. In the modified form by providing a special plug it is used for the dual function of both inlet and outlet passages. Also it should be noted that the drill bit shown provides for the seal bore in the cutter with an overhang which is larger in diameter than the seal hub to protect the seal from formation cuttings. Thus, even if the seal should fail, fluid circulation will continue through the bearing assembly both through the passages provided and out through the seal to provide continued drilling service from the improved drill bit of the present invention.

I claim:

1. A drill bit comprising:

a head defining an internal chamber;
a leg depending from said head;
said leg terminating in a bearing shaft;
a roller cutter adapted to be mounted on said bearing shaft;
bearing means supporting said roller cutter for rotation about said bearing shaft;
a seal positioned between the open end of said cutter and said shaft to prevent entry of solids to said bearing means between said roller cutter and said shaft;
a first passage through said leg and said bearing shaft communicating from said internal chamber to a position between said shaft and said cutter; and
a second passage extending through said shaft and said leg communicating from a position between said shaft and said cutter and spaced from said aforementioned position to the exterior of said leg whereby a portion of the fluid being circulated through said internal chamber is circulated through said first passage, between said shaft and said cutter, and through said second passage to cool said cutter and said shaft.

2. A drill bit according to claim **1**, wherein:
said first passage communicates with at least two spaced apart positions between said roller cutter and said bearing shaft; and
said second passage communicates with at least one position between said roller cutter and said bearing shaft spaced from both of said positions of said first passage.

3. A drill bit according to claim **1**, wherein:
said bearing means includes ball bearings and roller bearings; and
said passages are positioned to cause flow over said ball bearings and said roller bearings.

4. A drill bit according to claim **1**, wherein:
said second passage communicates with the exterior of said leg on the trailing side thereof.

5. A drill bit according to claim **4**, including:
a check valve positioned in said second passage to prevent flow through said second passage toward said bearing means.

6. A drill bit according to claim **1**, wherein:
said bearing means includes ball bearings;
said bearing shaft defines a ball loading hole;
a plug positioned in said ball loading hole; and
a portion of said ball loading hole providing a portion of at least one of said passages.

7. A drill bit according to claim **6**, wherein:
said plug has a reduced intermediate portion to provide space within said ball loading hole for flow of fluid therethrough.

8. A drill bit according to claim **6**, wherein:
a portion of said ball loading hole provides a portion of each of said passages.

9. A drill bit according to claim **8**, wherein:
said plug has a flattened intermediate portion dividing said ball loading hole into an inlet portion forming a portion of said first passage and an outlet portion forming a portion of said second passage.

10. A drill bit comprising:
a body;
a bearing shaft supported from the body;
a roller cutter adapted to be rotatively mounted on said bearing shaft;
bearing means supporting said cutter on said bearing shaft;
a chamber within said body and adapted to be in communication with the drilling fluid passage in a drill string when said drill bit is connected to the drill string; and
a plurality of passages communicating from said chamber to a first position between the bearing shaft and said cutter and from a second position between said bearing shaft and said cutter through said shaft and said body to the exterior of said body whereby drilling fluid is circulated through the space between said cutter and said bearing shaft.