United States Patent

Conn

[15] 3,705,635

[45] Dec. 12, 1972

[54] **LARGE DIAMETER EARTH BORING BIT**

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[21] Appl. No.: **106,220**

[52] **U.S. Cl.** **175/364**, 175/372, 308/8.2

[51] **Int. Cl.**.....**E21c 13/12**, F16c 19/08

[58] **Field of Search**.....308/8.2; 175/361–364, 371, 372, 359, 368, 344

[56] **References Cited**

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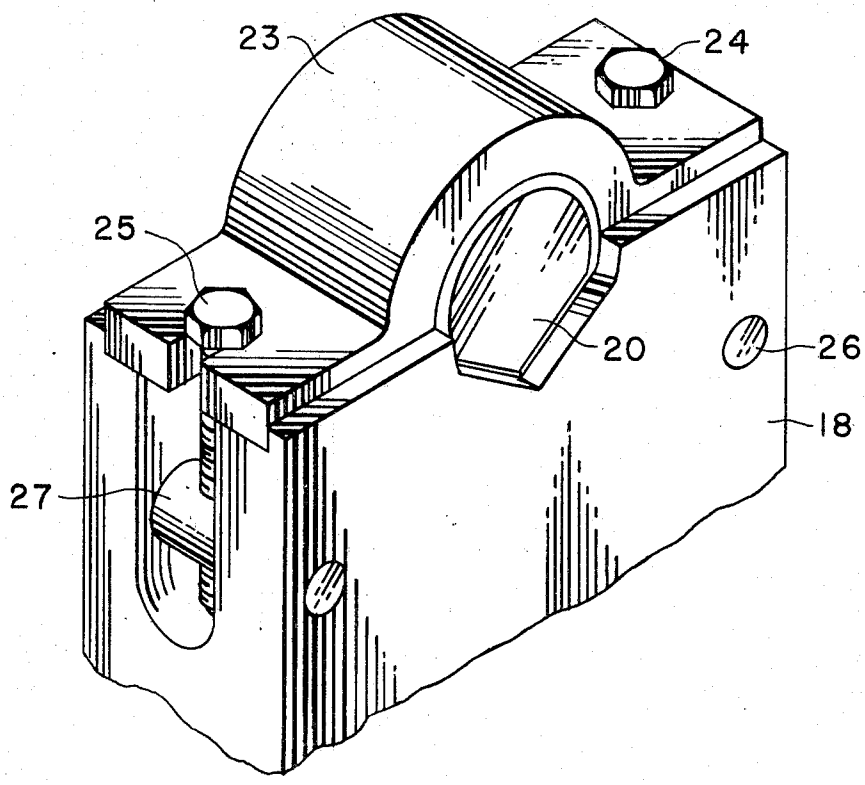
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[57] **ABSTRACT**

The rolling cutters of a large diameter earth boring bit are locked in place in a saddle mount yet may easily be removed. A vee-shaped, slabbed-off portion of the journal is held in place by a cap bolted to the saddle mount.

4 Claims, 6 Drawing Figures



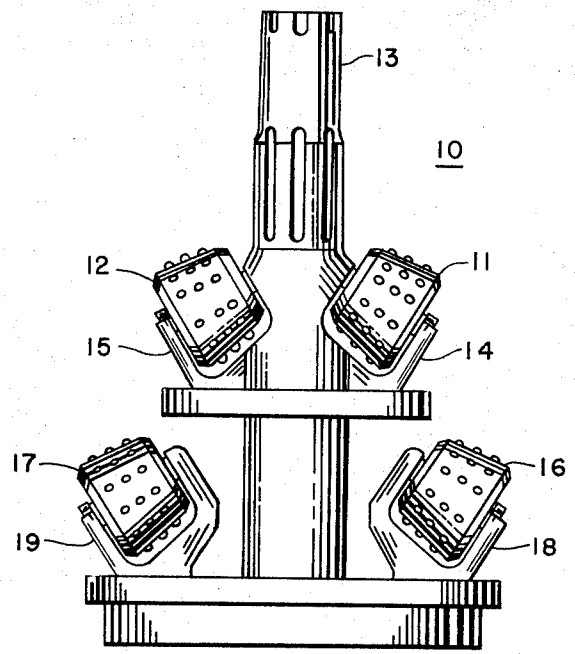


FIG. 1

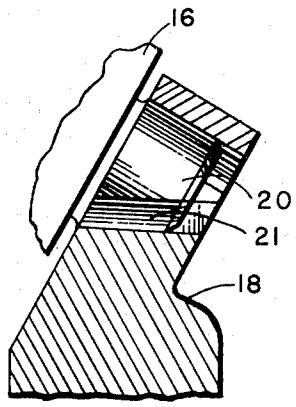


FIG. 2

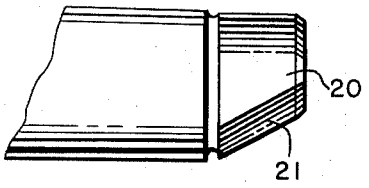


FIG. 3

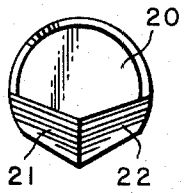


FIG. 4

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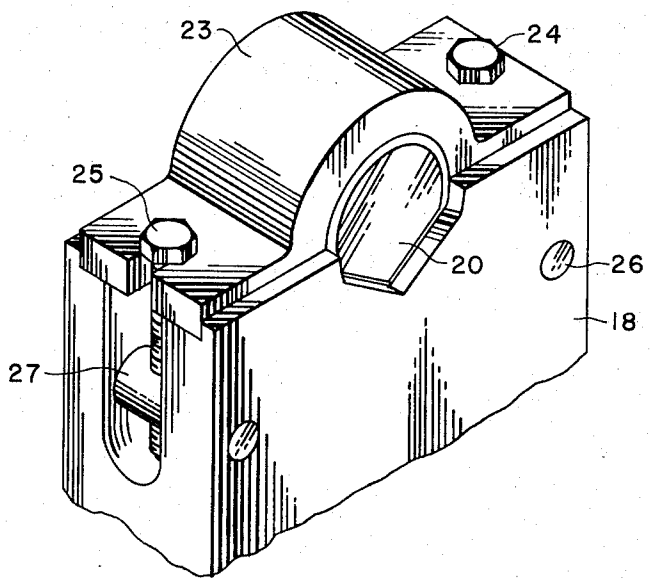


FIG. 5

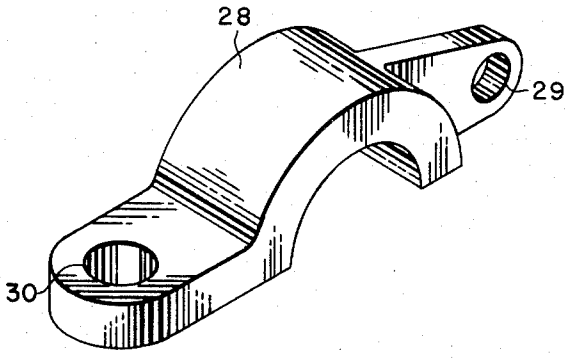


FIG. 6

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LARGE DIAMETER EARTH BORING BIT

BACKGROUND OF THE INVENTION

The present invention relates to an improved earth boring bit and more particularly to a removable cutter assembly for an earth boring bit that insures that the cutters will be locked firmly in place during drilling yet allows the cutters to be easily and quickly changed.

The cutter assembly of an earth boring bit must be easy to assembly, must lock firmly in place during operation and must be easy to disassemble. The cutter assembly generally operates under severe conditions and is subject to the corrosive forces of the drilling environment. In addition, the cutter assembly must be adapted to withstand heavy loading and high torque.

The rotatable cutters are positioned between a pair of support arms extending from the body of the bit. A journal assembly extends between the support arms and secures the cutter to the main bit body. The cutters have a useful lifetime that is much shorter than the lifetime of the bit. Consequently, means must be provided to allow the cutters to be changed. The heavy loading and high torque encountered during the drilling operation as well as the corrosive drilling environment complicates the problem of providing a cutter that will remain firmly in place during drilling yet may easily be changed.

DESCRIPTION OF THE PRIOR ART

A large diameter earth boring bit is shown in U.S. Pat. No. 3,203,492 to C. L. Lichte, patented Aug. 31, 1965. A number of small rotatable cutters are mounted in a multiplicity of saddles positioned on a large diameter earth boring bit. The bit is rotated and the cutters contact and disintegrate the earth formations. The cutters are removable by removing a retaining pin that extends between the arms of the saddles. The retaining pin is held in place by a nail-like locking element that is positioned in a groove in the saddle and a matching groove in the retaining pin.

In U.S. Pat. No. 3,389,760 to W. V. Morris, patented June 25, 1968, a rolling cutter for rock formations is shown mounted on a simple beam bearing. The cutter is positioned in a saddle that extends from the main bit body and is secured by a load pin. The load pin is firmly secured to the saddle by a retaining pin. The cutter may easily be disassembled by removing the retaining pin.

SUMMARY OF THE INVENTION

The present invention provides a simple and effective means of locking rotatable cutters in the saddles of an earth boring bit. The journal includes a vee-shaped lower portion that will take side loading and torque, and a slabbed-off portion that will take thrust. The journal is secured in place by a cap that is affixed to the saddle. The rotatable cutters may be easily changed yet are held securely in place during operation.

It is therefore an object of the present invention to provide an earth boring bit including rotatable cutters that may be easily and quickly changed.

It is a further object of the present invention to provide a simple and effective journal assembly for locking rotatable cutters on an earth boring bit.

It is a still further object of the present invention to provide a journal assembly for securing rotatable cutters on an earth boring bit that will take side loading and torque as well as thrust.

The above and other objects and advantages of the present invention will become apparent from a consideration of the following detailed description of the invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows an embodiment of a large diameter earth boring bit constructed in accordance with the present invention.

FIG. 2 is a side view of one of the journals shown mounted in one arm of the saddle of the earth boring bit shown in FIG. 1.

FIG. 3 is a side view of the journal shown in FIG. 2.

FIG. 4 is an end view of the journal shown in FIG. 3.

FIG. 5 shows the journal locked in place by a cap.

FIG. 6 illustrates another embodiment of the cap shown in FIG. 5.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to FIG. 1, a large diameter earth boring bit is shown generally at **10**. A first pair of rotatable cutters **11** and **12** are positioned next to the central shaft **13** and mounted in a pair of saddles **14** and **15**. At least two cutters are generally used at a given radius about the central shaft **13** to insure a balanced drilling bit and a smooth drilling operation. Saddles **14** and **15** allow the cutters to be easily removed and new cutters inserted. A second pair of cutters **16** and **17** are located below cutters **11** and **12**. Cutters **16** and **17** are mounted in a pair of saddles **18** and **19** mounted on the frame of the large diameter bit **10**. The upper end of shaft **13** is threaded to allow the bit to be connected to a rotary drill string (not shown).

The drilling operation generally proceeds by the drilling of a small diameter hole approximately the size of shaft **13**. The small diameter hole is drilled to an underground opening and the small diameter bit removed from the drill string. The large diameter bit **10** is then attached to the drill string and rotated and hydraulically raised along the pilot hole thereby enlarging it to the desired size. As bit **10** rotates, cutters **11**, **12**, **16** and **17** contact and disintegrate the formations. The cutting surfaces of cutters **11**, **12**, **16** and **17** should traverse the entire surface of the hole being drilled and the saddles and other portions of the bit should not contact the formation.

Difficulty has been encountered in providing adequate bearing support for the rotating cutters of the large diameter bit **10**. The bearing must be securely locked in place during drilling and must include means for releasing the cutters from the saddles to allow a change of cutters.

Saddle **18** is shown cut away in FIG. **2** to illustrate journal **20**. Journal **20** is positioned in the central annulus of cutter **16** and locked firmly in place, thereby securing cutter **16** in position during the drilling operation. The end of journal **20** is slabbed off forming a pair of surfaces **21** and **22** that are at an angle to the central axis of journal **20**. Surfaces **21** and **22** are best shown in the end view of FIG. **4**. The surfaces **21** and **22** meet to form a vee-shaped, slabbed-off end portion.

Referring now to FIG. 5, the journal 20 is shown mounted in one arm of saddle 18. A cap 23 is positioned on the arm of saddle 18 and held in place by bolts 24 and 25 locking journal 20 in place. Bolts 24 and 25 are pivotally mounted on cross frames 26 and 27. Cap 23 may be removed by loosening bolts 24 and 25 and pivoting them outward so that they are disengaged from cap 23. Once cap 23 has been removed, journal 20 may be disengaged from saddle 18 and the cutter 16 removed. A new cutter may then be inserted and locked in position by replacing cap 23 and bolts 24 and 25.

The vee-shaped, slabbed-off portion of journal 20 allows the assembly to take side loading, torque and thrust. The surfaces 21 and 22 allow the assembly to take side loading and torque. Journal 20 is thereby prevented from rotating in saddle 18 and will withstand the high loads applied by the rotational movement of bit 10. Because surfaces 21 and 22 are inclined to the central axis of journal 20, the assembly will withstand high thrust load such as those applied by pull of the drilling machine. As previously explained, the cutters may easily and quickly be changed by removing the caps holding the journals in place.

Referring now to FIG. 6, another embodiment of one of the caps for holding the journals in place is shown. Cap 28 shown in FIG. 6 may be pivoted about hinge element 29. This allows the cap 28 to be displaced by removal of a single bolt. Cap 28 is mounted on the saddle in the same manner as the cap of the previous embodiment. A bolt extends through opening 30 and a pin extends through hinge element 29 to secure cap 28 in place. When the journal is to be removed, the bolt is disengaged and cap 28 is pivoted on hinge element 29.

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

1. An earth boring bit comprising:

a main bit body;

at least one pair of support arms extending from said main bit body, at least one of the support arms having a pair of supporting surfaces;

a rolling cutter positioned between said pair of support arms, said rolling cutter having a central annulus;

a journal positioned in the central annulus of the rolling cutter and extending between said support arms, said journal including a vee-shaped end portion having a pair of journal surfaces that are at an angle to the central axis of said journal with said pair of journal surfaces adapted to engage said supporting surfaces on said at least one of the support arms; and

a cap removably connected to said one support arm for securing said journal and rolling cutter in position.

2. The earth boring bit of claim 1 wherein said cap is pivotally connected to said one support arm.

3. An apparatus for securing rotatable cutters in the support arms of a saddle of an earth boring head, said apparatus adapted to take side loading, torque and thrust, comprising:

a pair of adjacent supporting surfaces on one of said support arms;

a rolling cutter positioned in said saddle, said rolling cutter having a central annulus;

a journal positioned in the central annulus of the rolling cutter and extending between said support arms, said journal including a vee-shaped end portion having a pair of journal surfaces that are at an angle to the central axis of said journal with said pair of journal surfaces adapted to engage said supporting surfaces on said support arm; and

a cap removably connected to said support arm for securing said journal and rolling cutter in position.

4. The earth boring bit of claim 8 wherein said cap is pivotally connected to said one support arm.

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