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Goodfellow

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[54] ROTARY CUTTER FOR EXCAVATION, ESPECIALLY FOR USE WITH RAISE BORING AND TUNNEL BORING MACHINES

[72] Inventor: **Robert D. Goodfellow**, Bedford, Pa.

[73] Assignee: **Kennametal Inc.**, Latrobe, Pa.

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[51] **Int. Cl.**.....**E21b 9/22**, E21c 13/01, E21c 13/12

[58] **Field of Search**.....175/53, 410, 344, 351, 354, 175/358, 359, 363, 364, 368, 371–375, 361, 362; 308/812

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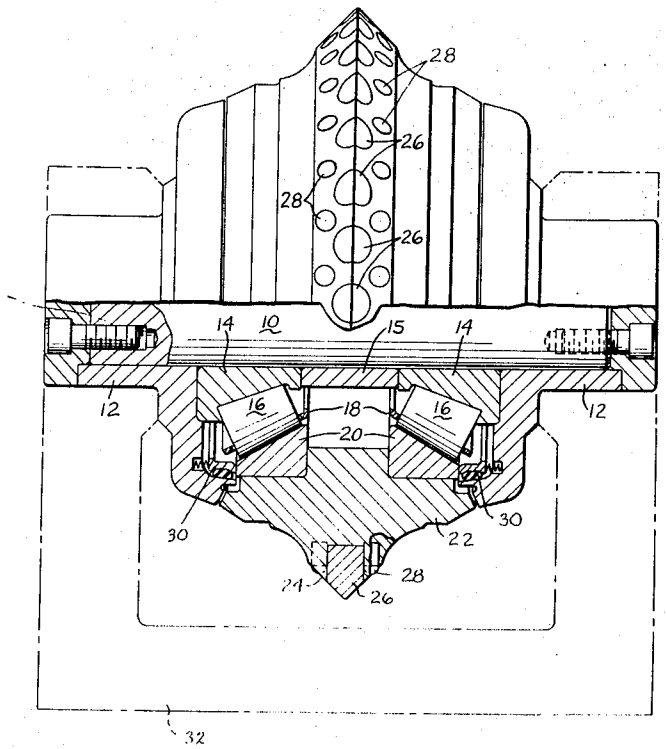
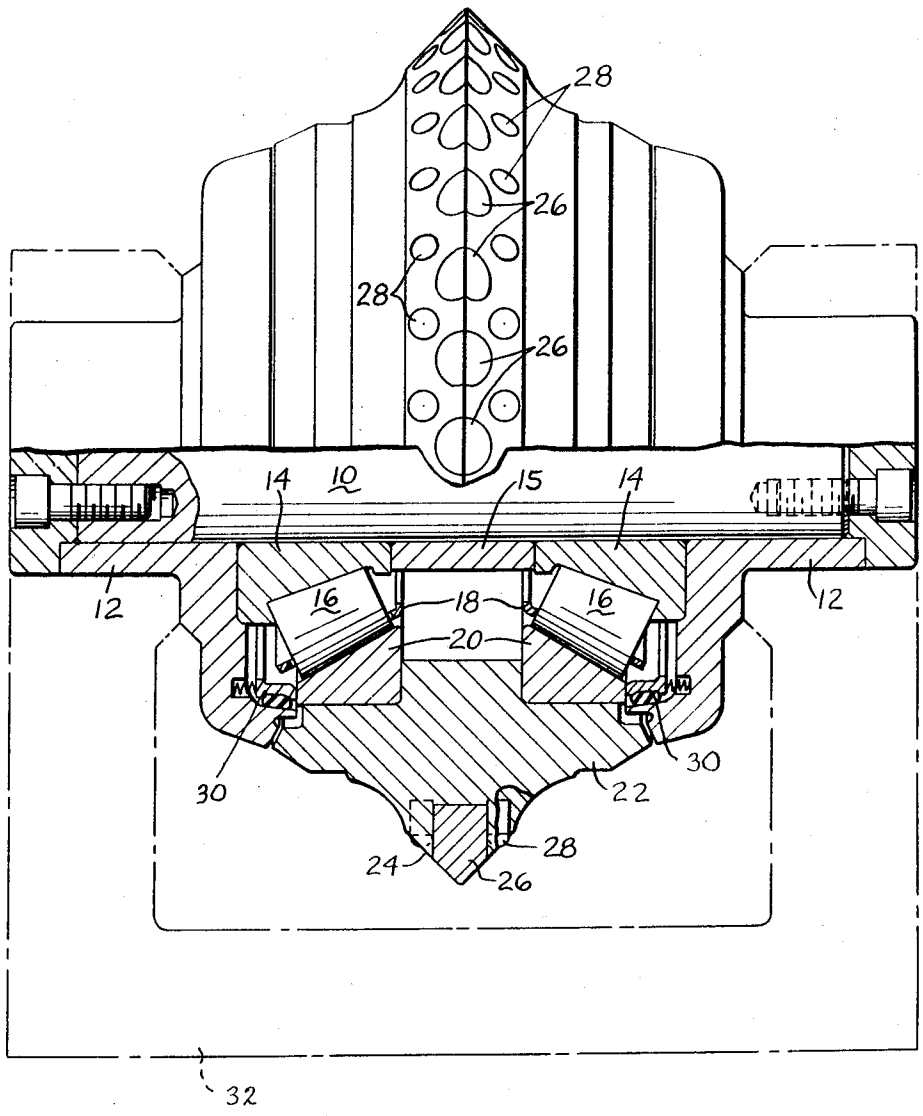
Primary Examiner—David H. Brown
Attorney—Melvin A. Crosby

[57] **ABSTRACT**

The specification discloses a rotary cutter in which a central support is mounted in a yoke or other supporting structure and which central support rotatably carries a cutting element having a central annular rib in which is mounted hard wear resistant inserts, such as cemented metal carbide inserts.

9 Claims, 1 Drawing Figure





INVENTOR.
ROBERT GOODFELLOW

BY

Melvin A. Crosby

ROTARY CUTTER FOR EXCAVATION, ESPECIALLY FOR USE WITH RAISE BORING AND TUNNEL BORING MACHINES

The present invention relates to rotary cutters, especially rotary cutters of the type employed in connection with raise boring and tunnel boring machines.

Cutters of the nature with which the present invention is concerned generally comprise a central supporting structure, such as a shaft, which has its opposite ends supported in a yoke like arrangement and on which shaft is mounted a rotary cutter member. The particular cutter with which the present invention is concerned has a central annular rib projecting therefrom which is pressed against a formation to be cut while the cutter is moved substantially in the plane of the aforementioned central rib so as to remove material from the formation.

Cutters of the nature referred to are generally mounted on relatively large supports or heads which are rotated while simultaneously being pressed toward the formation to be cut and in this manner dislodge material from the formation. In the main, cutters of the nature referred to are used for cutting, or material removing or excavating operations in connection with rather large holes such as holes for tunnels, or in connection with enlarging smaller holes, as is done in the mining technique referred to as "raise boring" wherein a horizontal shaft at one level might be connected with a horizontal shaft at another level.

Cutters of the nature employed in the aforementioned operations are subject to considerable wear and loading and must be capable of withstanding considerable shock and momentary overloads while reducing the formation engaged thereby.

The present invention is concerned with a cutter of the nature referred to so arranged and constructed as to provide for highly efficient reduction of a formation engaged by the cutter.

The present invention is also concerned with a cutter of the nature referred to which will have relatively long life while remaining in efficient operating condition.

Still further, the present invention is concerned with a cutter of the nature referred to having a steel body formed with a central rib and provided with hard wear resistant inserts, cemented metal carbide, for example, in the rib and so arranged and distributed therein as to provide for efficient reduction of the formation being worked while at the same time protecting the steel of the body of the cutter from being abraded away from the hard inserts which would detract from the support thereof.

The nature of the present invention will become more clearly apparent upon reference to the following detailed specification taken in connection with the accompanying drawing.

BRIEF SUMMARY OF THE INVENTION

The cutter of the present invention has a central support shaft on which a pair of anti-friction bearings are confined in axial spaced relation between confining end members fixed to the shaft. A steel cutter body is supported on the anti-friction bearings and is rotatably confined between the end members and is sealed thereto to maintain lubricant in the space occupied by the bearings while excluding foreign material therefrom.

The rotatable cutter body is formed of steel and has a radially outwardly projecting annular rib, preferably "V" shaped in cross section, and having inserted therein hard wear resistant inserts which might, for example, be in the form of a cemented metal carbide such as tungsten carbide.

According to the present invention, the inserts are arranged in the "V" shaped rib of the cutter body so that larger principal inserts are centrally located in the rib and are distributed uniformly about the circumference of the cutter body.

Further, smaller inserts are disposed in the lateral sides of the rib and are disposed circumferentially intermediate the larger inserts and in this manner serve to maintain the gauge of the rib while at the same time protecting the cutter body from being abraded away from the major inserts so that the major inserts are at all times adequately supported.

DETAILED DESCRIPTION OF THE INVENTION

In the drawing, support shaft **10** carries spaced end members **12** and between which are confined inner bearing races **14** of antifriction bearings, and a spacer **15**. The bearings include rollers **16**, cages **18** and outer races **20**. The outer races support a cylindrical rotary cutter element **22** having a single central radially outwardly projecting "V" shaped rib **24** provided with distributed radial holes in which are mounted carbide inserts **26** and **28**. Inserts **26** are mounted in the plane of the pick of the rib **24** and are cylindrical with the outer ends shaped to a "V" formation to conform to the shape of rib **24**.

The carbide inserts **28** are also cylindrical, but have rounded outer ends, and are arranged in planes on opposite sides of the central plane of the rib. The planes of the inner sides of inserts **28** are in about the planes of the outer sides of inserts **26**. Circumferentially, inserts **28** are disposed about midway between adjacent ones of the larger inserts **26**.

Inserts **28** not only assist in breaking up the formation against which the cutter is pressed, but, likewise, prevent the cutter body **22**, which is steel, from eroding away at the sides of inserts **26**. By thus preserving the support of inserts **26**, the life of the illustrated cutter is materially increased.

The space in which the bearings are located is sealed toward the outside, as by sealing rings **30**, to hold lubricant in the bearing space and keep foreign material out of the bearing space.

A cutter constructed as disclosed and described has long life and will withstand considerable abuse and remains in superior cutting condition due to the protection afforded the major inserts **26** by the smaller inserts **28** while the inserts **28** tend to maintain the gauge of the groove cut by the rib of the cutter body thereby preventing excessive wearing away of the steel of the cutter body along the sides of the ribs and which would seriously reduce the strength of the support for the main inserts **26**.

In the drawing, the cutter is shown schematically mounted in a "U" shaped support bracket **32** and which support bracket would be, in turn, secured to the rotary head of excavating equipment such as a tunnel boring or raise boring machine. However, other supporting arrangements are possible for connecting the cutter assembly to a driving head.

Modifications may be made within the scope of the appended claims.

What is claimed is:

1. A cutter, especially for use in hole forming and enlarging during excavating procedures, and comprising; a support shaft, bearing means on said shaft, end members fixed to said shaft and confining said bearing means therebetween on said shaft, a rotary cutting member surrounding said shaft between said end members and supported on said bearing means, said rotary cutting member having at least one outwardly projecting annular rib, and inserts of a hard wear resistant material imbedded in said rib and distributed circumferentially and axially on said cutting member, said inserts comprising first inserts located centrally in said rib, and second inserts located along the sides of said rib.

2. A cutter according to claim **1** in which said inserts comprise a cemented metal carbide.

3. A cutter according to claim **2** in which said carbide comprises tungsten carbide.

4. A cutter according to claim **1** in which said first inserts are spaced uniformly about the circumference of said rib and said second inserts are disposed in axially extending radial planes located about midway between each pair of first inserts whereby each first insert is centrally located within a group of four second inserts.

5. A cutter according to claim **4** in which said rib is "V" shaped and said first inserts are formed at the outer ends so as

to conform to the shape of said rib, said second inserts having rounded outer ends.

6. A cutter according to claim 5 in which said rib is "V" shaped and said first inserts are formed at the outer ends so as to conform to the shape of said rib, said first inserts having the central axes thereof in the central radial plane of said rib whereby the lateral sides of said first inserts lie in a pair of further radial planes on opposite sides of said central radial plane, said second inserts having the axes thereof in common radial planes and the axially inner sides thereof substantially in one of said further radial planes.

7. A cutter according to claim 1 in which all of said inserts are rod-like, said rib having substantially radial bores in which said inserts are mounted.

8. A cutter according to claim 7 in which said first inserts are larger in diameter than said second inserts.

9. A cutter according to claim 8 in which said rib is "V" shaped and said first inserts are formed at the outer ends so as to conform to the shape of said rib.

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