United States Patent

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[54] CUTTER ASSEMBLY
24 Claims, 6 Drawing Figs.

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[51] Int. Cl. E21b 9/08
[50] Field of Search 83/665, 666; 299/67, 68, 86; 308/8.2; 175/346, 347, 364, 313, 372

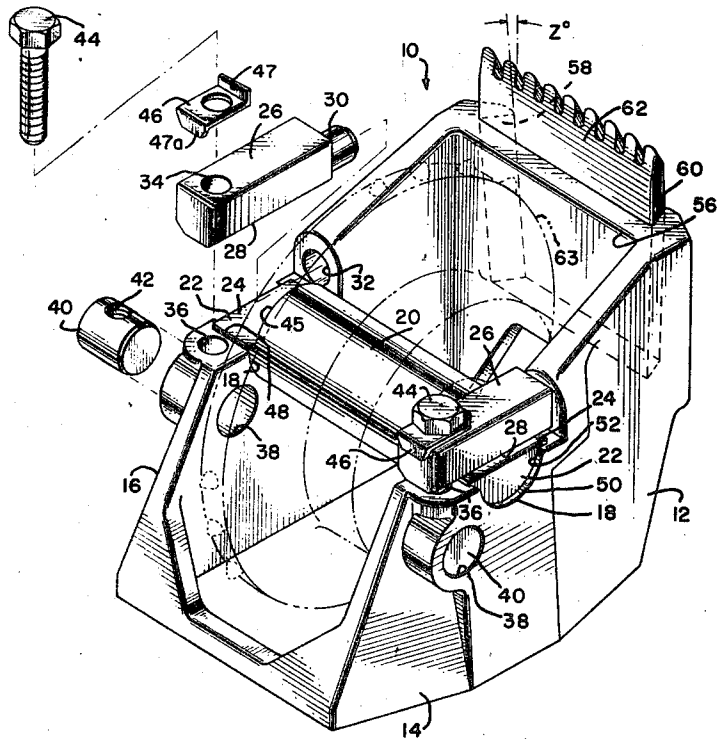
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ABSTRACT: A cutter assembly comprising a cage support in which a cutter is rotatably mounted on a shaft, the shaft and support having surfaces which are mutually engageable, and/or arranged for receiving penetrating hardware, to restrain the shaft against rotation. The cage support carries on integral socket for replaceably securing a scraper.



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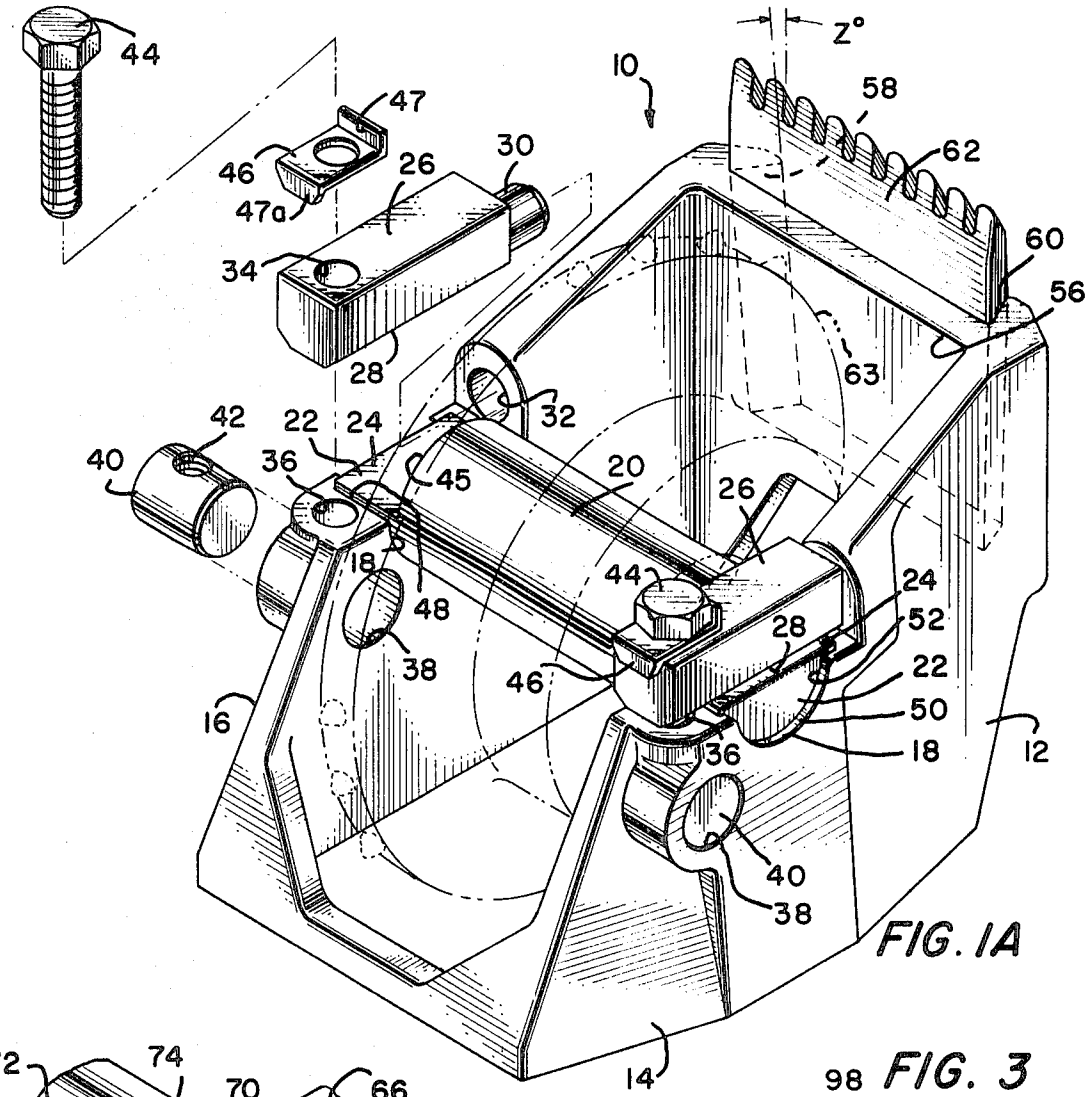


FIG. 1A

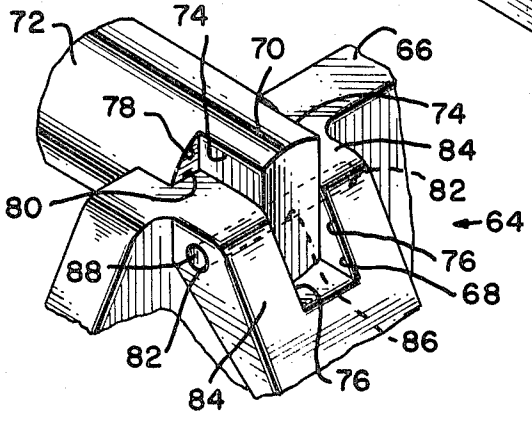


FIG. 2

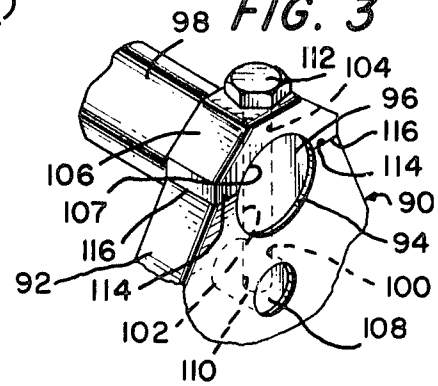


FIG. 3

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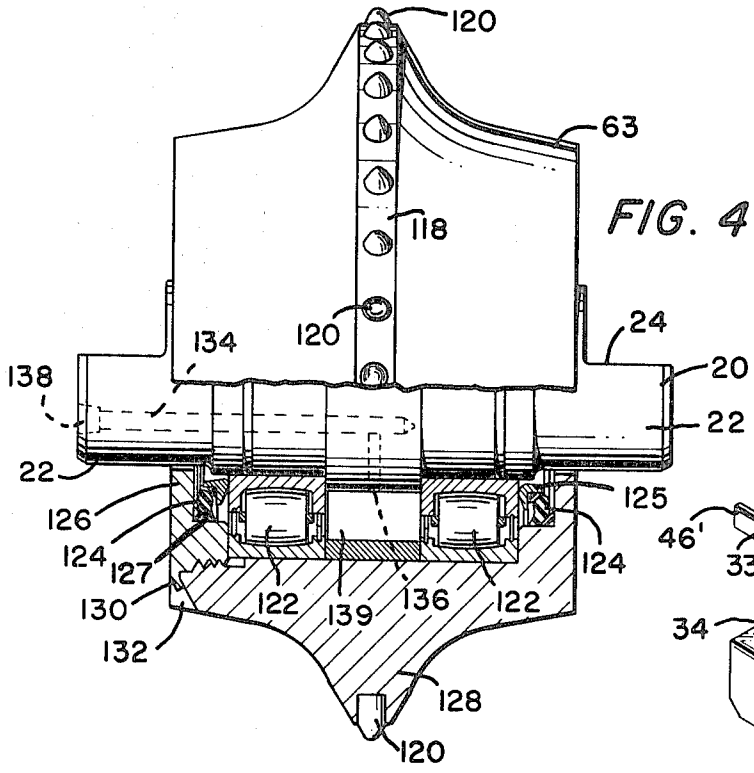


FIG. 4

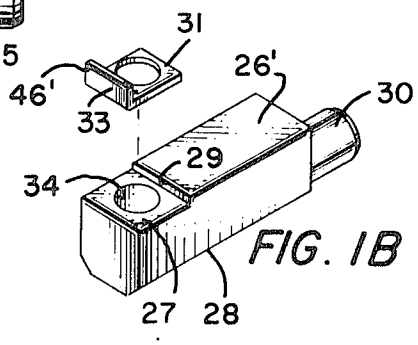


FIG. 1B

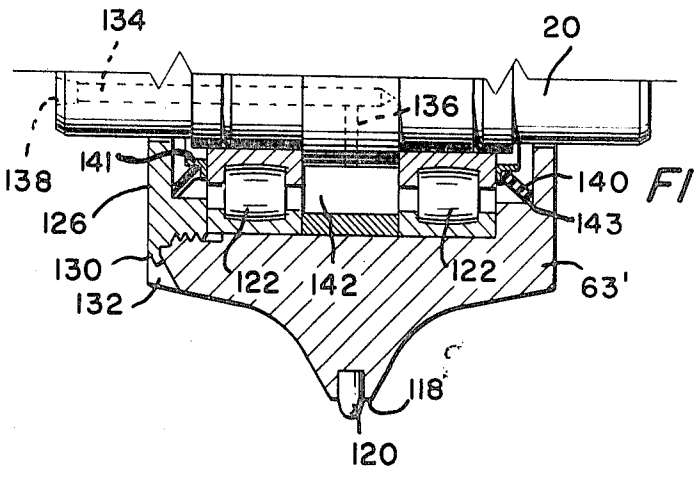


FIG. 5

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CUTTER ASSEMBLY

This invention pertains to a cutter assembly comprising means for supporting a shaft on which a cutter is rotatably mounted, and in particular to supporting means for a cutter and shaft which facilitates quick and simple cutter and shaft replacement.

In the prior art it is known to use a cage block which receives a bearing support fastened thereto by means of four or more cap screws, the bearing support being bored through for receiving a shaft on which a cutter is mounted. Additionally, retainer plates are disposed in the bearing support at either ends of the shaft and secured with hardware to retain the shaft in place against axial movement. This known arrangement makes replacement of the cutter and shaft a laboriously involved process.

In addition, it is common in the prior art to provide a separate mounting support on the cutterhead, or whatever, to receive a scraper, the scraper being mounted adjacent to the cutter to clear a path in advance thereof. Here too, additional hardware is involved for securing the scraper in the support.

It is an object of this invention, then, to provide a cutter assembly which comprises a cutter and shaft and supporting means therefor which facilitates simple and rapid replacement of the cutter and shaft. It is another object of this invention to provide a cutter assembly comprising a scraper support integral with supporting means for a cutter and shaft.

A feature of this invention, in one embodiment thereof, comprises the provisioning of a cage-type support having a relieved area or cove of given shape in a wall thereof and a shaft having a complementary relieved surface, the cove and shaft complementary surfaces being engageable to restrain the shaft against rotation relative to the support.

Further objects and features of this invention will become more apparent by reference to the following description taken in conjunction with the accompanying figures in which:

FIG. 1A is an isometric projection of the cutter and shaft, and supporting means therefor, which comprise the cutter assembly, according to the invention, in which the cutter is shown phantomed to facilitate a clear understanding of the shape of the cage-type support cage, and hardware and retainers deployed to retain the shaft are shown in exploded view at one shaft end;

FIG. 1B depicts an alternate arrangement of hardware for use in a cutter assembly such as that of the FIG. 1A embodiment;

FIGS. 2 and 3 show, in isometric projections, portions of cutter assemblies, according to our invention, in which alternate embodiments of the novel means for mounting the shaft are illustrated; and

FIGS. 4 and 5, vertical illustrations having partial cross sections, present configurations of cutters employed in the cutter assemblies according to our invention.

As shown in FIG. 1 a cutter assembly **10** comprises a support **12** of a "cage" configuration which comprises oppositely disposed sidewalls **14** and **16** which have arcuate relieved areas or coves **18** for receiving a shaft **20**. The shaft **20** is deployed for mounting a cutter and has terminal portions **22** which have flattened surfaces **24** provided for arresting the shaft against rotation. A pair of bars **26**, which also have flattened surfaces **28**, are disposed across surfaces **24** to restrain the shaft. Bars **26** each have a dowel extension **30** which is engaged with a borehole **32** formed in each of the walls **14** and **16**. Additionally, bars **26** have boltholes **34** formed therethrough which are in alignment with boltholes **36** formed in walls **14** and **16** to receive mounting hardware. Also, each wall **14** and **16** has a nut hole **38** in which is disposed a round, or rod nut **40** which nut has a tapped bolthole **42** therein. On assembly, with bars **26** in place upon the terminal portions **22** of shaft **20**, the boltholes **34** and **36** and the tapped holes **42** are in alignment, and receive bolts **44** for securing the bars **26** in place. Chordal shoulders **45** of shaft **20** have bars **26** disposed next thereto.

A locking plate **46** is disposed between the head of the bolts **44** and bars **26** so that the extending tangs **47**, **47***a* of the locking plate may be turned against a flatted surface of the hex head of the bolt, and one end of bar **26**, respectively, to secure the bolt against loosening.

The coves **18** have first and second radial dimensions **48** and **50** which accordingly form therebetween a shoulder **52**. The terminal ends of portions **22** of shaft **20** abut the shoulder **52** to secure the shaft-end cutter against axial movement, and the arcuate, radial surfaces **54** of portions **22** nestingly engage the first radial dimension **48** of cove **18**.

Walls **14** and **16** are joined by a further wall **56** on the rear of which, i.e., "rear" meaning the surface of wall **56** which is external of the assembly, are formed converging tracks **58** and **60**. Tracks **58** and **60** comprise a tapered socket which frictionally receives and holds a scraper **62** for disposition in advance of the cutter **63**. Each track **58** and **60** is inclined from the vertical at a slight angle Z, and the scraper **62** has a complementary tapered configuration.

This embodiment of our cutter assembly just described greatly facilitates and simplifies replacement of cutter **63** together with shaft **20**, in that it only requires the removal of two bolts **44** to enable a disengagement of the cutter and shaft from the support **12**. Yet, on assembly, the complementary linear surfaces **28** and **24** secure the shaft against rotation. Further, shoulder **52** constrains the shaft **20** against axial displacement. In other embodiments of our invention we teach the use of complementary linear surfaces in the same manner to both secure the shaft against rotation, as well as axial displacement, and to enable quick and easy replacement of the shaft and cutter, as shown in FIG. **2** for instance.

Alternately, a cutter assembly, such as that of assembly **10** of FIG. 1A, can deploy modified hardware-retaining components. Such a modification is shown in FIG. 1B where a bar **26'**, similar to that of bar **26** in FIG. 1A, is used. Bar **26'** has a relieved land **27** formed thereon which terminates, at one end, in a stop shoulder **29**. Land **27** and shoulder **29** are provisioned to receive a locking plate **46'**. Upon assembly, bolt **44** (FIG. 1A) is passed through the hole provisioned in plate **46'**, and boltholes **34** and **36** of bar **26'** and walls **14** and **16** (FIG. 1A). The one flatted end **31** of plate **46'** abuts shoulder **29**, and the other end **33** is turned up to engage a flatted portion of the head of bolt **44** after the bolt is fully torqued in place in rod nut **40**.

In FIG. **2** a support **64** is indicated with a fragment of a sidewall **66** which has a relieved area or cove **68** formed therein. Cove **68** receives a terminal portion **70** of a shaft **72**. The terminal portion has flatted surfaces **74** on opposite sides which nest with and engage flatted surfaces **76** formed at either sides of the cove **68**. Surfaces **76** are formed in the otherwise circular shaft **72** and extend perpendicularly from chordal shoulders **78** which bear against shouldered surfaces **80** presented at either side of cove **68**. A pinhole **82** is formed to either side of cove **68**, through buttresses **84**, and the terminal portion **70** of the shaft **72** has a complementary pinhole **86**. Accordingly, the pinholes are in alignment and receive a locking pin **88**. In this embodiment of our invention the flatted surfaces **74** and **76** comprise complementary linear surfaces which restrain the shaft against rotation, and shaft and cutter replacement in this embodiment is very simply accomplished by removing pin **88** from the buttresses **84** and pinholes.

In a further embodiment of our invention, as shown in FIG. **3**, a fragment of a support **90** is presented as comprising a wall **92** which has a cove **94** formed therein to receive the terminal portion **96** of a shaft **98**. A bolthole **100** is formed in wall **92**, and aligns with boltholes **102** and **104** formed in terminal portion **96** and a pillow block cap **106**, respectively. The pillow block cap **106** surmounts the terminal portion **96** of the shaft, and has an arcuate surface **107** which engages said portion. A rod-nut **108**, which has a tapped bore **110** therein, is carried in wall **92**. A bolt **112** is disposed through the bolt holes, and it engages rod nut **108**, both to secure the cap **106** to the wall **92**, and to restrain the shaft **98** against rotation. In addition sur-

faces 114 and 116, respectively, of the wall and cap are in abutting engagement to add further restraint against rotation of the shaft.

The rod-nuts 40 and 108, shown in FIGs. 1 and 3, are provided to guard the supports 12 and 90, respectively, against stripped-thread damage. Should it occur that bolts 44 and/or 112 are overtorqued—or otherwise overstress the threads in rod-nuts 40 and/or 108—it is then only necessary to replace the rod-nuts.

In FIG. 4 there is more fully illustrated the cutter 63 which was indicated only in phantom in FIG. 1. Cutter 63 has a row 118 of cutting elements 120 and is mounted on shaft 20. Shaft 20 has the prior-noted terminal portions 22 with the flatted portions 24 for engagement with the bars 26. In this partial cross section it is shown that the cutter 63 has a pair of spherical roller bearings 122 disposed therewithin to facilitate its rotation relative to shaft 20. Cylindrical roller bearings or ball bearings could be used in alternate embodiments of our invention, in place of spherical roller bearings 122, provided that such roller bearings or ball bearings have adequate radial and thrust load capacity. Metal-to-metal face seals 124 protect the bearings against the introduction of dirt and other foreign matter. A bearing retainer 126 is threadably engaged with one end of the cutter shell 128 for positioning and securing the bearings in place. A tang 130 is deformed from the retainer, and disposed in a slot 132 provided therefor in cutter shell 128. Finally, shaft 20 has a lube passageway 134 formed therein extending axially to the center thereof where it is joined by radial passageway 136. The external end of passageway 134 opens on a pipe plug bore 138. The passageways are provided for charging the bearing chamber 139 of cutter 63 with lubricant after which the passageways are sealed by the implacement of a pipe plug (not shown) in bore 138.

Each seal 124 comprises a rotating metal face or annulus 125 and a resilient ring 127 which resiliently constrains the annulus against the inner race of bearing 122. Annulus 125 and ring 127 rotate in unison with shell 128, annulus 125 all the while sliding or rubbing against the bearing race.

In FIG. 5 we show an alternate cutter 63′ usable at least, with the embodiment of FIG. 1—in place of cutter 63—in which compliant seals 140 are shown at either sides of bearings 122 for sealing the lubricant-charged bearing chamber 142.

Seals 140 are also of the rotating metal face type. Each comprises a rotating annulus 141 resiliently constrained against the inner race of bearing 122 by a resilient ring 143. Seal 140 rotates in unison with the shell 128, annulus 141 all the while sliding about the bearing race.

While we have described our invention in connection with specific embodiments thereof it is to be clearly understood that this is done only by way of example and not as a limitation to the scope of our invention as set forth in the objects thereof and in the appended claims.

We claim:

1. A cutter assembly, comprising:
a cutter shaft having a longitudinal axis; and means supporting said shaft at least on one end of said shaft axis; wherein
said supporting means comprises a cage-type support having oppositely disposed sidewalls joined by a further wall;
said shaft has at least one given linear surface which lies transverse to said axis;
at least one of said sidewalls includes means having at least one complementary linear surface in mating engagement with said given surface to restrain said shaft against rotation; and
said further wall includes means for replaceably and only frictionally mounting a scraper for clearing a path in advance of a cutter mounted to said shaft.

2. A cutter assembly, according to claim 1, wherein:
said one sidewall has a relieved area therein in which a portion of said shaft is disposed.

3. A cutter assembly, according to claim 2, further including:
fastener means, in penetration of said one sidewall and said portion securing said portion, in said relieved area.

4. A cutter assembly, according to claim 3, wherein:
said fastening means comprise a pin.

5. A cutter assembly, according to claim 2, wherein:
said relieved area defines a cove extending into one lateral edge of said one sidewall.

6. A cutter assembly, according to claim 5, wherein:
said cove is defined by rectilinear sides.

7. A cutter assembly, according to claim 6, wherein:
said shaft, excepting at least said portion, is of circular cross section; and
said portion has parallel, flatted surfaces, extending perpendicularly from adjacent chordal shoulders, which matingly engage said rectilinear sides.

8. A cutter assembly, according to claim 7, wherein:
said chordal shoulders abut said one sidewall.

9. A cutter assembly, according to claim 5, wherein:
said cove is defined by arcuate sides.

10. A cutter assembly, according to claim 9, wherein:
said arcuate sides each have a different radius which sides together define a semiannular, stepped shoulder therebetween; and
a terminal end of aid portion abuttingly engages said shoulder.

11. A cutter assembly, according to claim 10, wherein:
said shaft excepting at least said portion, is of circular cross section; and
said portion has a flatted surface, extending perpendicularly from an adjacent chordal shoulder, and an arcuate, radial surface contiguous with said flatted surface, which arcuate surface nestingly engages one of said arcuate sides.

12. A cutter assembly, according to claim 11, wherein:
said complementary linear-surfaced means comprise retainer means in fastened engagement with said one sidewall, and overlying said portion in restraining engagement with said flatted surface.

13. A cutter assembly, according to claim 12, wherein:
said retainer means comprises a bar having one end in penetration of said one sidewall, and the other end thereof having a bolthole formed therethrough, and includes a bolt in penetration of said bolthole fastened in, and securing said bar to, said one sidewall.

14. A cutter assembly, according to claim 13, wherein:
said one sidewall carries a rod-nut therewithin with which said bolt is threadedly engaged.

15. A cutter assembly, according to claim 9, wherein:
said complementary linear-surfaced means comprise retainer means in fastened engagement with said one sidewall, and overlying said portion.

16. A cutter assembly, according to claim 15, wherein:
said shaft has a first, linear, borehole formed therethrough, within said portion; and
said retainer means comprises a pillow-block-type cap having a shaft-engaging surface, and a second linear borehole formed therethrough in registry with said first borehole, and a bolt fastened in, and securing said cap to, said one sidewall and restraining said shaft against rotation.

17. A cutter assembly, according to claim 16, wherein:
said cap-bearing surfaces in abutting engagement with complementary surfaces of said one sidewall which are cooperative with said bolt to restrain said shaft against rotation.

18. A cutter assembly, according to claim 1, wherein:
said mounting means comprises a socket defined by opposed and converging tracks.

19. A cutter assembly, according to claim 1, further including:
cutter means carried by said shaft; and
means interposed between said shaft and said cutter means facilitating rotation of the latter relative to the former.

20. A cutter assembly, according to claim 19, wherein:

said rotation-facilitating means comprise spherical roller bearings.

21. A cutter assembly, according to claim 20, wherein:

said cutter means include chamber means for accommodating said bearings; and

said shaft has lubricant passageways formed therein, in communication with said chamber means, for lubricant-charging of said chamber means.

22. A cutter assembly, according to claim 21, further including:

metal-to-metal, face-type seals closing said chamber means against foreign matter.

23. A cutter assembly, according to claim 21, further including compliant seals closing said chamber means against foreign matter.

24. A cutter assembly, according to claim 22, wherein:

said seals comprise resiliently mounted metal annuluses rotatably with said cutter means and slidably engaged with, and resiliently constrained against races of said roller bearings.