US 20040179938A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2004/0179938 A1

Smith (43) Pub. Date: Sep. 16, 2004

(54) ROTOR FOR SPRAYING COOLANT ONTO A CUTTER

(76) Inventor: Darrin Eugene Smith, Barrie (CA)

Correspondence Address:
BIRCH STEWART KOLASCH & BIRCH
PO BOX 747
FALLS CHURCH, VA 22040-0747 (US)

(21) Appl. No.: 10/795,400

(22) Filed: Mar. 9, 2004

(30) Foreign Application Priority Data

Mar. 10, 2003 (CA) 2,421,459

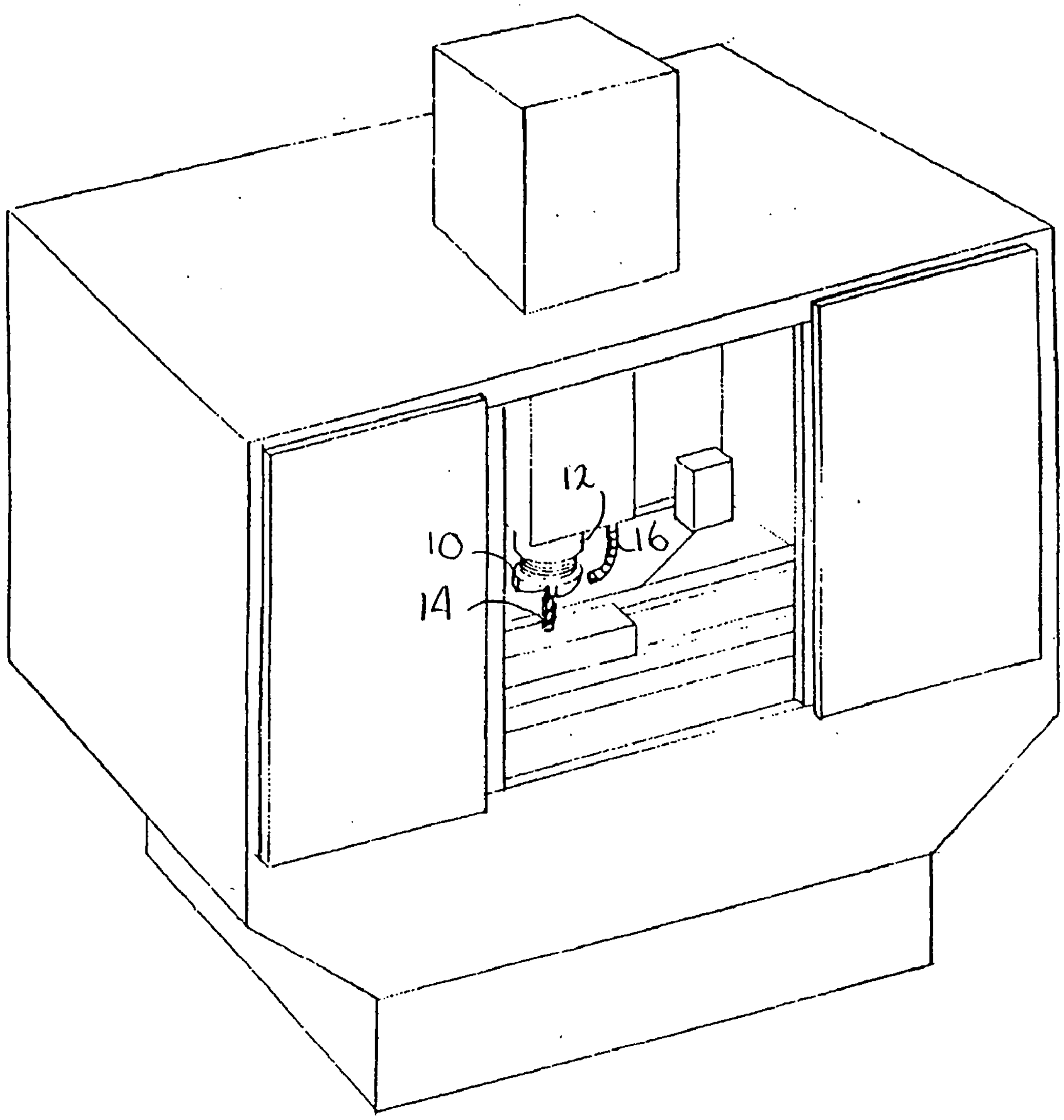
Publication Classification

(51) Int. Cl.[7] F01D 1/02

(52) U.S. Cl. 415/202

(57) ABSTRACT

The rotor is positioned above a work-piece and has a number of curved downwardly extending blades. A nozzle directs cooling liquid onto the leading surface of successive blades as the rotor rotates The blades re-direct the cooling liquid against a bit or drill used to cut the work-piece. The blades also direct the liquid into the pocket cut by the bit or drill in the work-piece in order to drive out any debris which collects in the pocket.



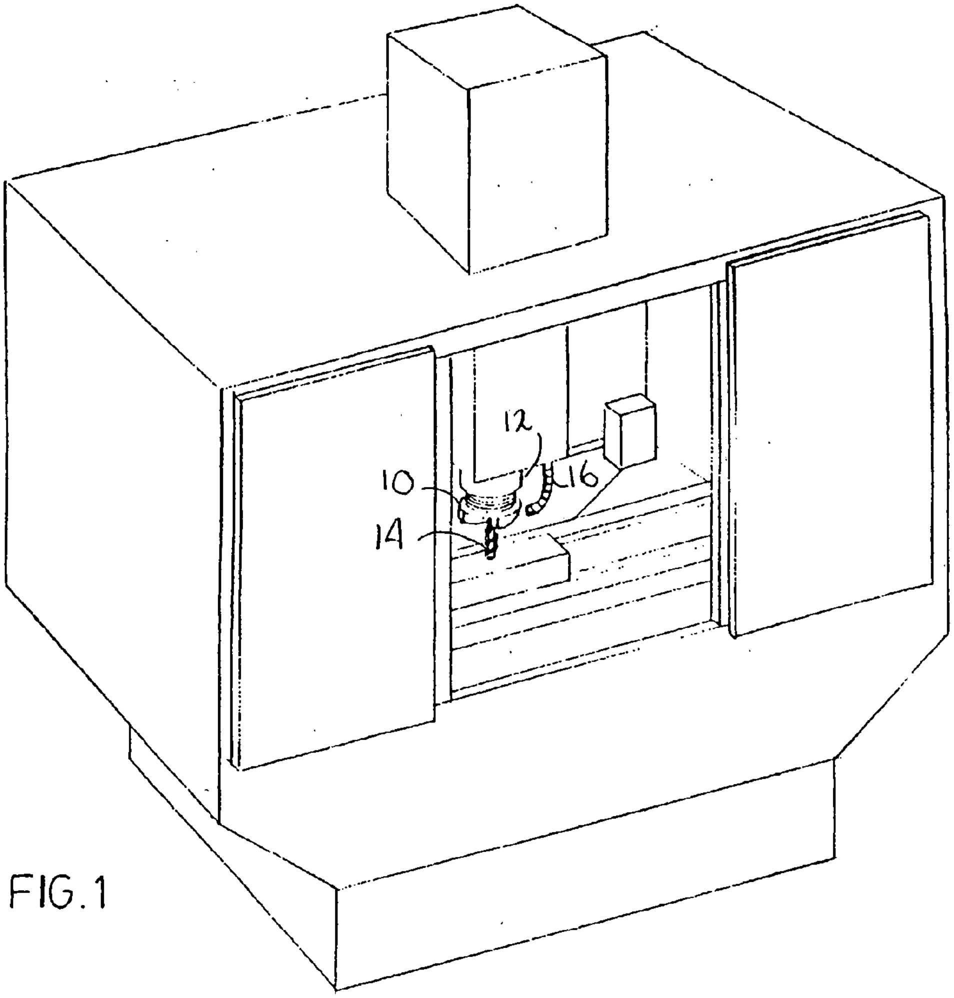


FIG. 1

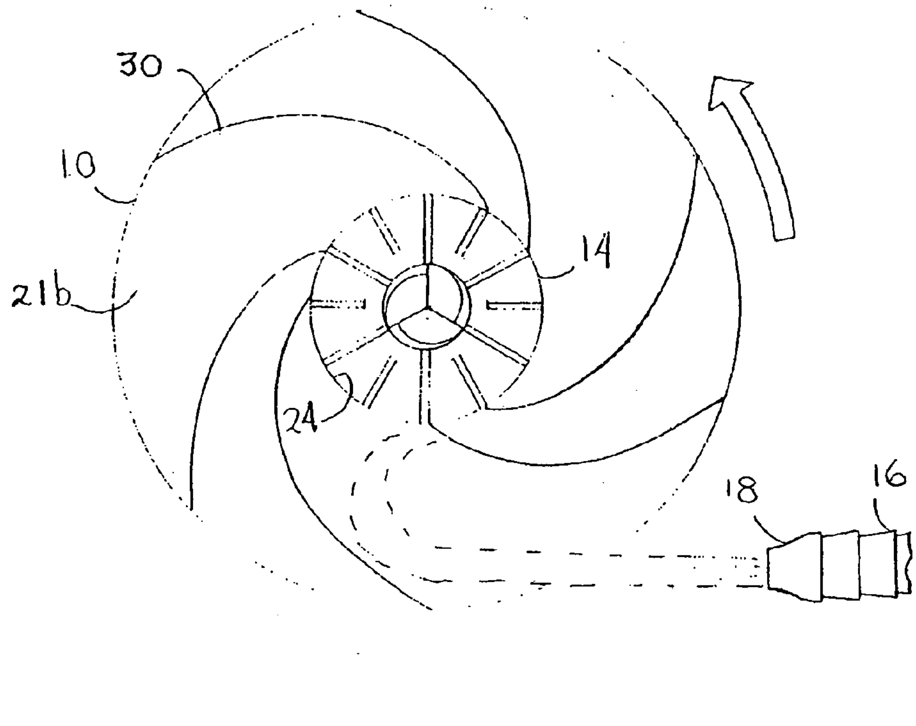


FIG. 2

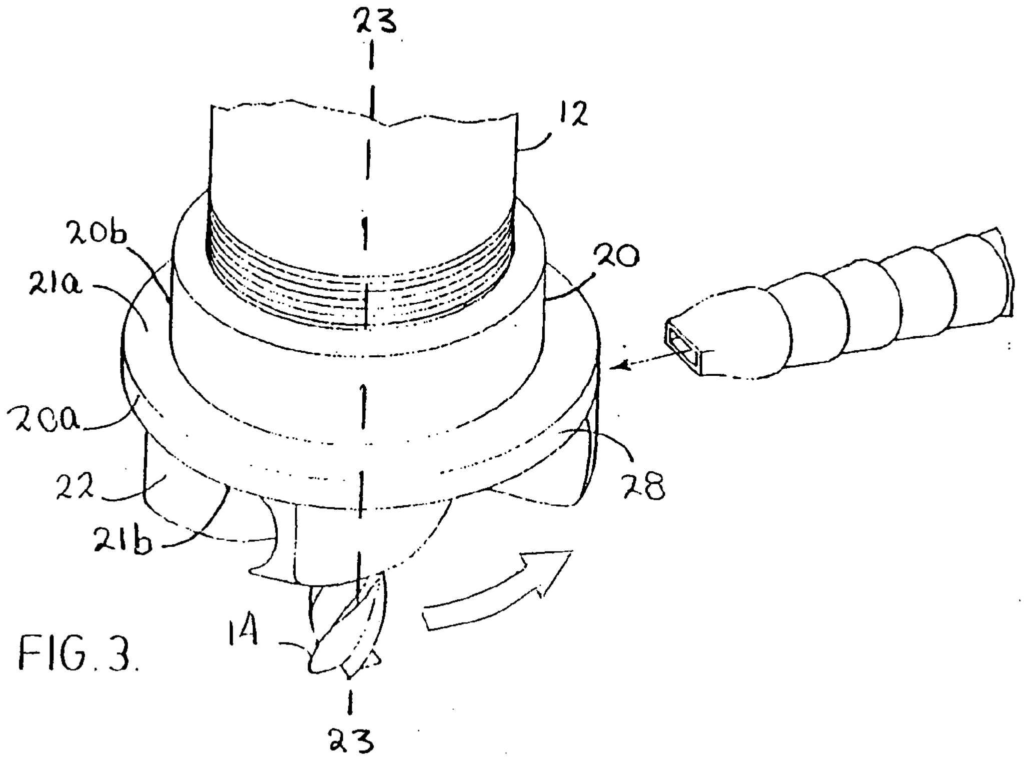


FIG. 3.

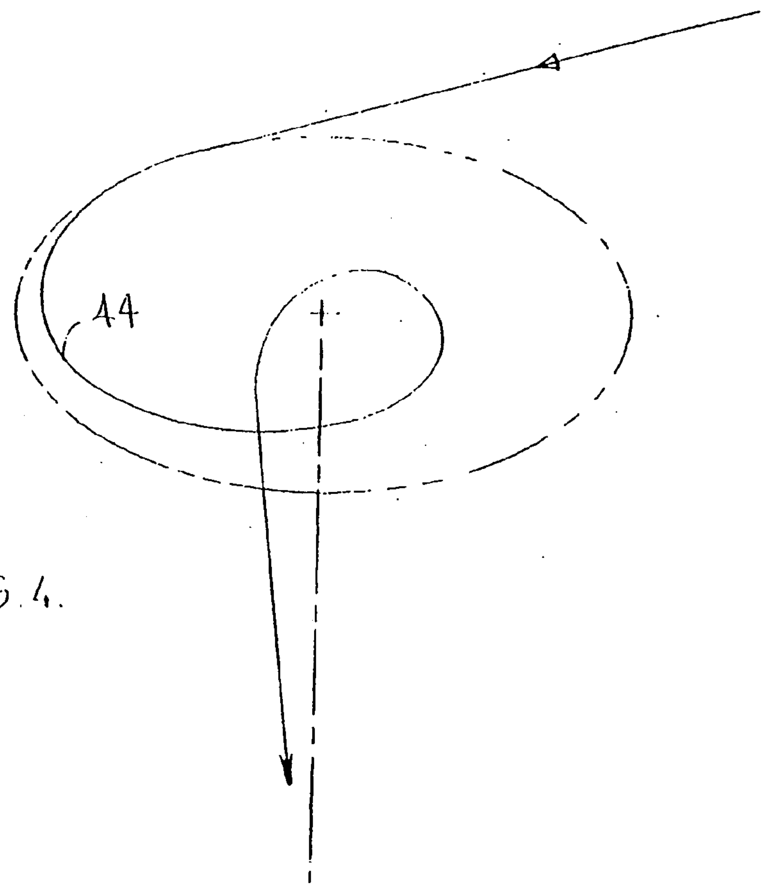


FIG. 4.

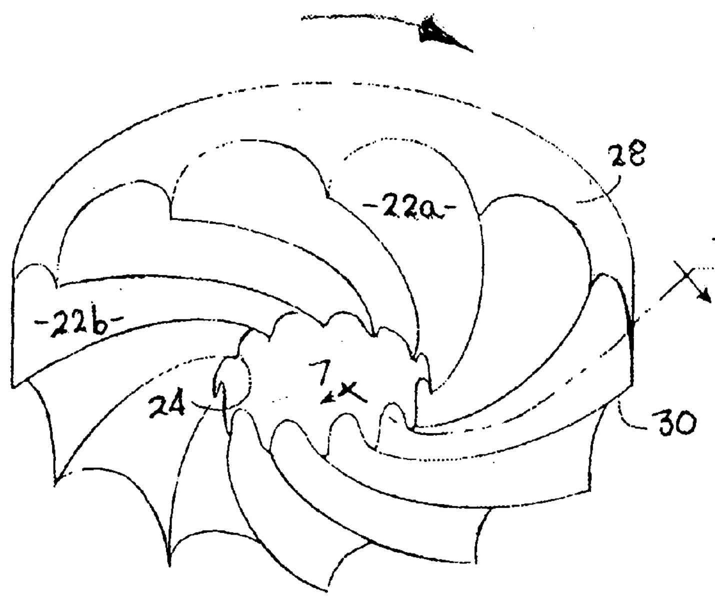


FIG. 5.

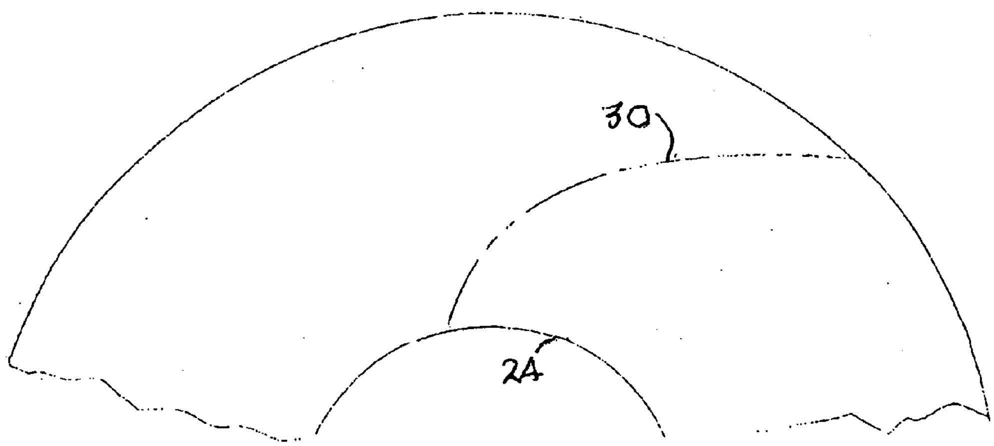


FIG. 6.

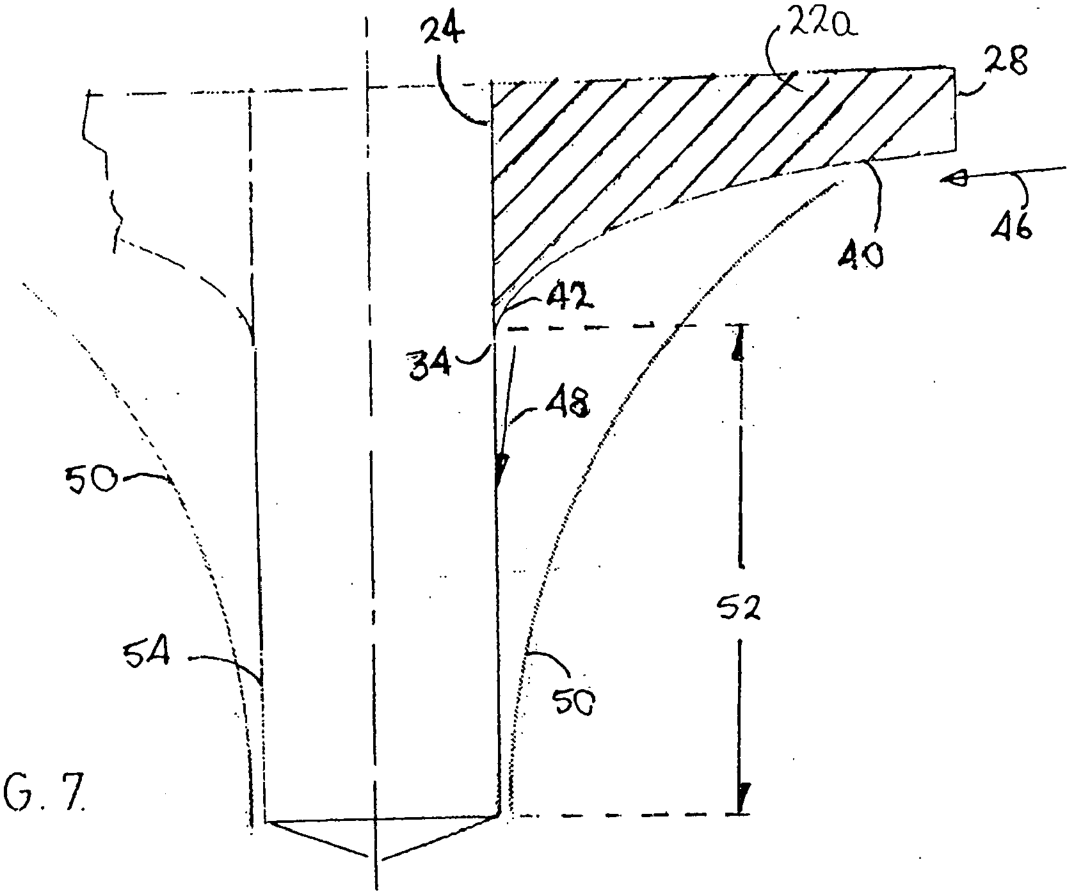


FIG. 7

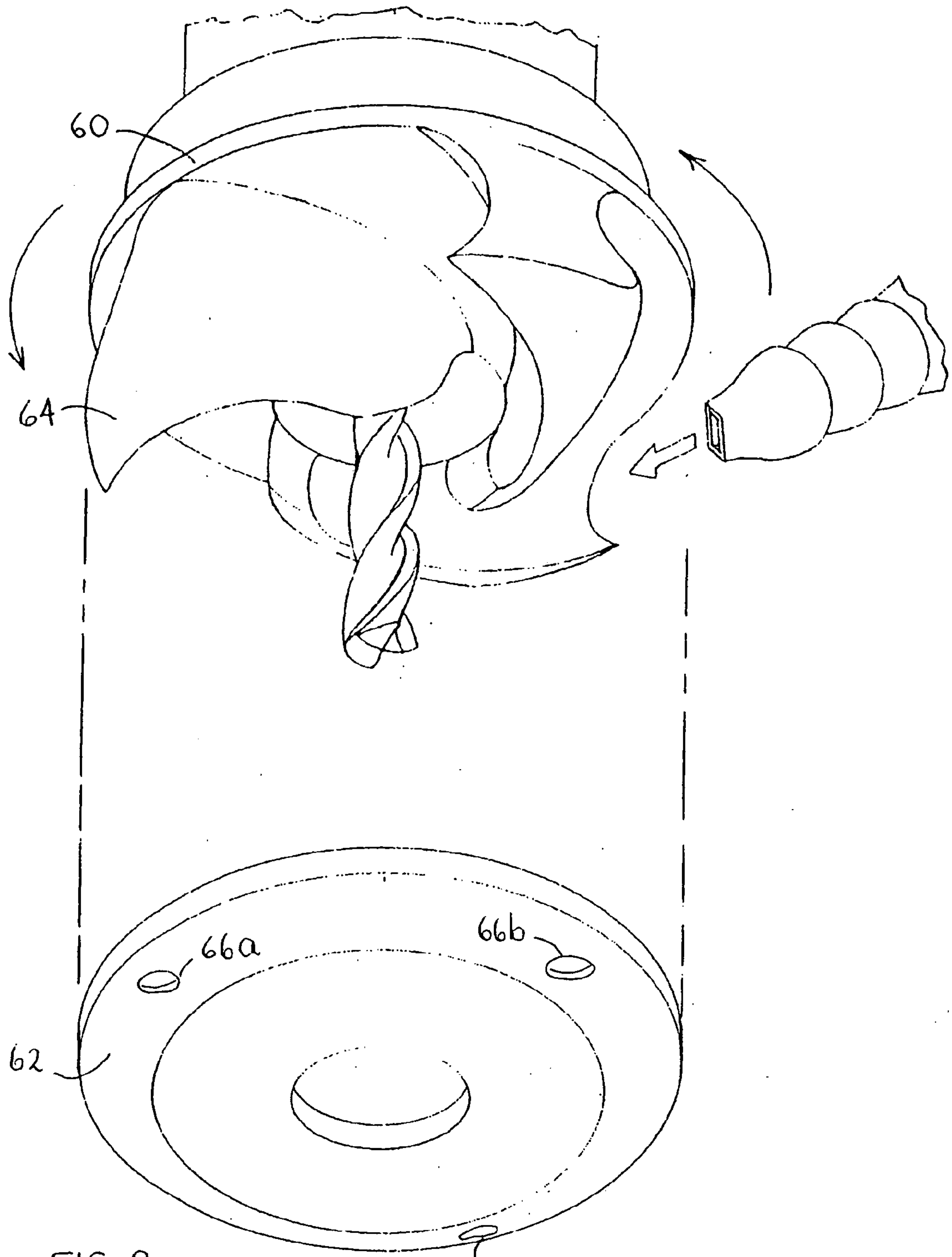


FIG. 8.

ROTOR FOR SPRAYING COOLANT ONTO A CUTTER

FIELD OF THE INVENTION

[0001] This invention relates to an apparatus for directing cooling liquid onto a cutting implement and more particularly to a rotor for causing cooling liquid to form an envelope which surrounds the cutting implement on all sides to ensure more effective cooling.

BACKGROUND OF THE INVENTION

[0002] In an automated machine for drilling, cutting or milling a workpiece, the cutting implement operates at such a high speed that a great deal of heat is generated. The heat must be dissipated to avoid damage to the cutter and the usual way of doing so is to direct a continuous stream of cooling liquid against the cutter as it operates. The stream is conventionally directed against one side of the cutter and because the cutter is rotating, all sides of the cutter are contacted by the liquid.

[0003] Cooling of a cutter in this way has a number of shortcomings. First, because the cutter is rotating so rapidly, much of the cooling liquid rebounds off the cutter. As a result the cooling effect of much of the liquid is lost because it is flung away by the cutter as soon as it touches it. Secondly, the cooling liquid does not contact the hottest part of the cutter, namely the part that is doing the actual cutting. That is because once the initial cut is made in the workpiece, the cutting part of the cutter is within a recess or "pocket" where it is inaccessible to the cooling liquid.

[0004] A third problem that arises from the use of a stream of cooling liquid to cool the cutter results from debris generated from the cutting operation. The debris collects in the pocket where it impairs the cutting operation by causing excessive heat to build up in the pocket since it is in constant contact with the cutter. In addition the debris increases the cost of the cutting operation because it is cut and re-cut by the cutter, all of which requires energy.

[0005] The cooling liquid cannot remove debris in a pocket if the liquid is directed against the cutter. If, on the other hand, the coolant is directed against the debris itself, only the debris on the side of the pocket which is actually contacted by the coolant will be blasted from the pocket. Debris on the opposite side of the pocket will remain in the pocket and continue to cause problems.

[0006] There are other problems too numerous to mention which result from cooling a cutter in this way.

[0007] I have found a way of avoiding or lessening many of these problems by means of a rotor which is mounted for rotation on or adjacent to the chuck which holds the cutter. The rotor has a number of blades which convert the linear stream of cooling liquid to an envelope of coolant. The envelope surrounds the cutter where it cools all sides of the cutter. The coolant can be directed downwardly against the whole area of the cutter beneath the rotor, the area of the cutter that is actually doing the cutting, into the pocket or against all areas of the cutter beneath the rotor as well as into the pocket.

[0008] The coolant, being in the form of an envelope, is more effective to cool the cutter and to blast the debris on all sides of the cutter from the pocket.

SUMMARY OF THE INVENTION

[0009] Briefly, the rotor of my invention comprises includes at least one blade which is adapted to receive a stream of cooling liquid directed thereon. The blade is arranged and constructed such that it re-directs cooling liquid against a cutting implement. Preferably there is more than one blade and each is helical in shape. The blades radiate outwardly from the axis of the rotor and have oppositely facing leading and trailing surfaces. The leading surfaces are adapted to receive a stream of cooling liquid directed thereon and the blades are arranged and constructed to re-direct the cooling liquid downwardly in the form of an envelope that surrounds and cools the cutting implement.

DESCRIPTION OF THE DRAWINGS

[0010] The apparatus of the invention is described with reference to the accompanying drawings in which:

[0011] **FIG. 1** is a perspective view of a cabinet containing the rotor of the invention in conjunction with nozzle for a cooling liquid and a bit held in a chuck;

[0012] **FIG. 2** is a view from beneath the rotor, bit and nozzle;

[0013] **FIG. 3** is a perspective view of the rotor and nozzle in conjunction with a bit;

[0014] **FIG. 4** shows the path followed by the cooling liquid as it flows into contact with the rotor, as it is rotated by the rotor and as it discharges from the rotor;

[0015] **FIG. 5** is a perspective view of the blades of the rotor;

[0016] **FIG. 6** is partial view, in enlarged scale, of the rotor from beneath it;

[0017] **FIG. 7** is a view on line **7-7** of **FIG. 5**; and

[0018] **FIG. 8** is a perspective view of the rotor, nozzle and a plate for directing the path of the cooling liquid as it discharges from the rotor.

[0019] Like reference characters refer to like parts throughout the description of the drawings.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0020] With reference to **FIGS. 1 and 2**, the apparatus of the invention includes a rotor **10** which is mounted to the outer wall of a chuck **12** and is rotated by the chuck. The chuck holds a bit **14** and a tube **16** carries cooling liquid which discharges onto the rotor through nozzle **18**.

[0021] With reference to **FIGS. 2 and 3**, the rotor includes a main body **20** having an annulus **20***a* which extends radially outward from a collar **20***b*. The collar is threaded to chuck **12**. The annulus has oppositely facing upper and lower walls **21***a,b* and a number of curved blades **22** which extend downwardly from lower wall **21***b*. The blades radiate outwardly from the axis **23-23** of the annulus. Each blade commences at the central opening **24** of the annulus and terminates at its circular outer edge. The chuck **12** and bit **14** extend through the central opening.

[0022] With reference to **FIG. 5**, each blade has a trailing and leading surface **22***a,b* which intersect at a curved lower edge **30**. When the lower edge is viewed from beneath the rotor, as illustrated in **FIG. 2** and also in **FIG. 6**, the edge has the shape of a spiral curve truncated by the central opening **24**.

[**0023**] When the blades are viewed from the side, and with reference to **FIGS. 5 and 7**, the leading surface **22***a* of each blade curves downward from the outer edge **28** of the annulus and terminates at its central opening **24**. The lowest point **34** of each blade defines the central opening.

[**0024**] The slope of the leading surface increases smoothly from a minimum adjacent to the outer edge of the annulus to a maximum at the central opening **24**. Adjacent to the outer edge, as at **40**, the slope is virtually horizontal while adjacent to the central opening, as at **42**, the slope approaches the vertical.

[**0025**] With reference to **FIG. 4**, cooling liquid discharges through nozzle **18** onto the leading surface of each blade. When the stream of liquid contacts a blade, the blade causes the liquid to travel in a spiral or helical path **44** at increasing velocity toward the centre of the rotor. As previously indicated and with reference to **FIG. 7**, the path will initially be horizontal as illustrated by arrow **46** but that will change to the vertical, as illustrated by arrow **48** when the liquid reaches the central opening of the rotor.

[**0026**] Thus when the cooling liquid exits from the blades it will be travelling downward in a stream in the shape of a hollow cone **50** that tapers downwardly. The leading surface is configured such that the cone has a substantial thickness **52** in the area of contact of the cone with bit **54** so that the cooling liquid cools the entire length of the bit beneath the chuck. Of course the leading surface can be configured so that the cooling liquid contacts less than the entire area of the bit or contacts a selective area of the bit should that be necessary. The leading surface can also be configured so that the cooling liquid forms a cylinder that extends downwardly to the work-piece.

[**0027**] As the bit cuts a work-piece, a recess or "pocket" will form. It is desirable that cooling fluid enter the pocket at high pressure to blast out the debris that collects in the pocket as the cutting operation proceeds. For that to occur, the velocity of the cooling liquid that exits from the rotor must be of sufficient force.

[**0028**] Not only does the configuration of the leading surface of the blade affect the shape of the stream of cooling liquid but so too does the rate of rotation of the rotor. The faster the rotor rotates, the greater the centrifugal force will be that acts on the cooling liquid. As a result, the angle of taper of the cone of cooling liquid as it travels downward from rotor will become increasingly more shallow as the rate or rotation of the rotor increases.

[**0029**] Thus, the configuration of the leading surface of the blades and the speed of rotation of the blades affect the path of the cone of cooling liquid that flows downward from the rotor.

[**0030**] With reference to **FIG. 8**, the rotor **60** has a similar construction to the rotor depicted in the previous drawings except that it has a plate **62** which is mounted to the rotor beneath blades **64**. The plate rotates with the rotor and is provided with three apertures **66***a,b,c* through which the stream of cooling liquid flows. The liquid is directed downward by the blades before it contacts the apertures and it discharges through those apertures.

[**0031**] The location of apertures **66** will influence the path of the cooling liquid beneath the plate. Should for example there be an aperture vertically below the lowest point of each blade, the liquid will flow directly through those apertures. The size of the apertures will determine the size of the flow which discharges through them. Location of the apertures elsewhere will affect not only the size but the direction of the flow of cooling liquid.

[**0032**] It will be understood of course that modifications can be made in the embodiments of the rotor described herein without departing from the scope of the invention as defined by the appended claims.

I claim:

1. A rotor for causing cooling liquid to contact a cutting implement rotating about an axis, said rotor including a blade; means for discharging a stream of cooling liquid against said blade, said blade being arranged and constructed to re-direct the cooling liquid against said cutting implement.

2. The rotor of claim 1 wherein said blade has leading and trailing surfaces, said discharging means directing the stream of cooling liquid against said leading surface.

3. A rotor for causing cooling liquid to contact a cutting implement rotating about an axis, said rotor including a plurality of blades which radiate outwardly from said axis and which have leading and trailing surfaces, means for discharging a stream of cooling liquid against said blades, said blades being arranged and constructed to re-direct the cooling liquid against said cutting implement.

4. The rotor of claim 3 wherein said discharging means directs the stream of cooling liquid against the leading surfaces of successive said blades as said rotor rotates.

5. The rotor of claim 3 wherein said blades are arranged and constructed to re-direct the cooling liquid in a stream which surrounds said cutting implement.

6. The rotor of claim 5 wherein said blades are arranged and constructed to re-direct the cooling liquid in a conical shaped stream.

7. The rotor of claim 5 wherein said blades are arranged and constructed to re-direct the cooling liquid in a stream in the shape of a downwardly tapering cone.

8. The rotor of claim 3 wherein said rotor is concentrically mounted for rotation about said axis.

9. The rotor of claim 3 wherein said blades are spiral-shaped.

10. The rotor of claim 3 wherein said rotor has spaced outer and inner walls, the inner wall defining a space through which said cutting tool passes, the edge of each said blade commencing at said outer wall and curving downwardly toward said inner wall.

11. The rotor of claim 3 further including a plate disposed below said rotor, said plate having at least one aperture through which the stream of downwardly directed cooling liquid flows.

12. The rotor of claim 11 wherein said plate rotates with said rotor.

13. The rotor of claim 12 wherein said plate is arranged and constructed to cause said cooling liquid to travel in a spiral shaped stream as it travels downwardly from said plate.

14. A method of cooling a cutting implement rotating about an axis including providing a rotor having a blade; directing a stream of cooling liquid against said blade, adjusting the orientation of said blade relative to said stream in order to cause said blade to re-direct the cooling liquid against said cutting implement.

15. The method of claim 14 including causing said rotor to rotate such that a surface of said blade leads the remainder of said blade; and directing said stream against the leading surface of said rotor.

16. The method of cooling a cutting implement rotating about an axis including providing a rotor having a plurality of curved blades; causing said rotor to rotate such that a surface of each said blade leads the remainder of said blade; directing a stream of cooling liquid against the leading surfaces of successive said blades as said rotor rotates; adjusting the orientation of said blades relative to said stream in order to cause said blades to re-direct the cooling liquid against said cutting implement.

17. The method of claim 16 including arranging and constructing said blades in order to cause them to re-direct the cooling liquid in a stream which surrounds said cutting implement.

18. The method of claim 16 including arranging and constructing said blades in order to cause them to re-direct the cooling liquid in a conical shaped stream.

19. The method of claim 16 including arranging and constructing said blades in order to cause them to re-direct the cooling liquid in the shape of a downwardly tapering cone.

20. The method of claim 16 including mounting said rotor to rotate concentrically about said axis.

21. The method of claim 16 including selecting spiral-shaped blades for the blades of the rotor.

* * * * *