



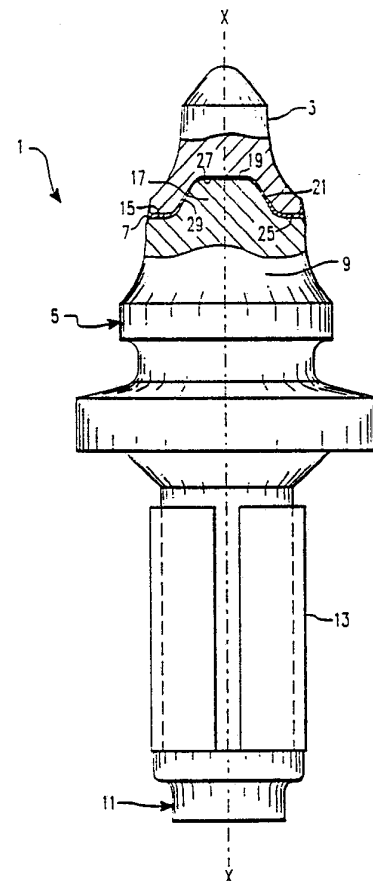
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/US89/03057 (22) International Filing Date: 13 July 1989 (13.07.89) (30) Priority data: 221,819 20 July 1988 (20.07.88) US 303,514 27 January 1989 (27.01.89) US (71) Applicant: KENNAMETAL INC. [US/US]; P.O. Box 231, Latrobe, PA 15650 (US). (72) Inventor: STIFFLER, Stephen, P. ; R.D. ,1, Box 187, Enterprise, PA 16664 (US). (74) Agents: PRIZZI, John, J. et al.; Kennametal Inc., P.O. Box 231, Latrobe, PA 15650 (US).</p>		<p>(81) Designated States: AT (European patent), AU, BE (European patent), CH (European patent), DE (European patent), FR (European patent), GB (European patent), IT (European patent), JP, KR, LU (European patent), NL (European patent), SE (European patent), SU. Published <i>With international search report.</i></p>

(54) Title: CEMENTED CARBIDE TIP

(57) Abstract

A cemented carbide tip (3) for a cutter bit (1) is rotationally symmetric about its longitudinal axis (x-x) and has a socket (23) in its rear end for brazing to a steel protrusion (17) on a steel tool shank (5). The tip socket (23) and an outer rear-most facing surface (25) on the tip rear end have respective pluralities of first and second dimples (31, 32) thereon for spacing, centering and aligning the tip (3) on the bit body (5) to facilitate formation of a braze joint (7) of a desired given cross-sectional thickness profile between the tip (3) and bit body (5).



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CEMENTED CARBIDE TIPBACKGROUND OF THE INVENTION

5 The present invention relates to a wear resistant tip design for attachment to cutter bits for use in construction and excavation. It especially relates to cemented carbide tips.

10 In the past, a variety of cutter bit designs have been used in construction and excavation applications. These cutter bits have typically been tipped with a cemented tungsten carbide-cobalt insert which was brazed to the steel shank or body of the tool.

15 Both rotatable and nonrotatable cutter bits have been used in these applications. One of the early rotatable cutter bit designs involved a cemented carbide tip having an annular rear surface with a socket therein to which the forward end of the steel shank was brazed. The forward end of the steel shank had an annular forward surface with a forward projection thereon which partially extended into the socket (i.e., the depth of the socket was greater than the height of the forward projection). The braze joint between the steel and the cemented carbide was thus thickest at the forward end of the steel projection and thinnest at the facing annular surfaces of the cemented carbide and steel. While rotatable cutter bits of the foregoing design were commercially used, the
20 cemented carbide of the tip was susceptible to fracture
25

during usage.

The foregoing design was superseded by rotatable cutter bit designs in which the rear of the carbide was flat, or had a so-called valve seat design, either of which was brazed into a socket in the forward end of the steel (see, for example, United States Patent Nos. 4,497,520 and 4,216,832, and West German Offenlegungsschrift No. 2846744).

Examples of cutter bit designs utilizing a socket in the rear of the carbide are shown in South African Patent No. 82/9343; Russian Inventor's Certificate No. 402655; Published Swedish Patent Application No. 8400269-0 and United States Patent No. 4,547,020.

SUMMARY OF THE INVENTION

In accordance with the present invention, an improved cemented carbide tip is provided for use as the forward end of a cutter bit. The tip is rotationally symmetric about its longitudinal axis and has a rearward end for attachment to a ferrous metal body. The tip rearward end has an annular rearwardly facing outer surface and an inner socket extending forwardly therefrom and being shaped to fit with a protrusion on the ferrous body of the cutter bit. Further, the tip is provided with means protruding from its rearward end on at least one of the outer surface and inner socket thereof for engaging the end of the ferrous body and placing the tip in a spaced relationship relative thereto for facilitating formation therebetween of a braze joint having a predetermined cross-sectional thickness profile.

More particularly, preferably, the protruding means includes pluralities of first and second dimples. The first dimples are formed on the inner socket of the rearward tip end and spaced from one another. For example, the first dimples are three in number being

circumferentially spaced approximately 120 degrees from each other. The second dimples are formed on the outer surface of the rearward tip end and spaced from one another. For example, the second dimples are four in number being circumferentially spaced approximately 90 degrees from each other.

These and other aspects of the present invention will become more apparent upon review of the drawings, which are briefly described below in conjunction with the detailed description of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows an elevational view of one embodiment of a cutter bit in accordance with the present invention in partial cross section.

Figure 2 shows an enlarged view of the braze joint shown in cross section in Figure 1.

Figure 3 shows a rear plan view of the rear end of the embodiment of the tip shown in Figures 1 and 2.

Figure 4 shows an elevational view of the embodiment of the tip in partial cross section.

Figure 5 shows half of an elevational view of the embodiment of the tip shown in Figure 4.

Figure 6 shows a view similar to that of Figure 2 but of another embodiment of the tip.

Figure 7 shows a view similar to that of Figure 3 but of another embodiment of the tip.

Figure 8 shows a view similar to that of Figure 4 but of another embodiment of the tip.

Figure 9 shows an enlarged longitudinal axial sectional view of still another embodiment of the tip.

Figure 10 shows an enlarged fragmentary longitudinal axial sectional view of still another embodiment of the bit body.

DETAILED DESCRIPTION OF THE INVENTION

Shown in Figure 1 is one embodiment of rotatable cutter bit 1 having a cemented tungsten carbide-cobalt tip 3 joined to a ferrous metal body 5, here steel, by a braze joint 7. The steel body 5 extends along and is preferably rotationally symmetric about a longitudinal axis X-X which extends between the forward end 9 and rearward end 11 of the body 5. The rearward end 11 of the steel body 5 may have loosely retained thereon a resilient retainer member 13 for releasably holding the cutter bit rotatable in the bore of a mounting block on a conventional construction or excavating machine (not shown). This and other styles of resilient retainer means useful with the present invention are described in United States Patent Nos. 3,519,309 and 4,201,421.

The forward end 9 of the ferrous body 5 has a first annular forwardly facing surface 15 which preferably lies in a plane perpendicular to the longitudinal axis. Radially inside of this first forwardly facing surface 15 is a protrusion 17 extending forwardly therefrom. At the forward end of the protrusion 17 is a second forwardly facing surface 19 which preferably lies in a plane perpendicular to the longitudinal axis. The first and second forwardly facing surfaces are joined by an outwardly facing surface 21 which tapers inwardly as it extends forwardly, or is preferably frustoconical in shape, and is rotationally symmetric about longitudinal axis X-X. All sharp inside and outside corners preferably are removed and replaced by fillets or chamfers.

The height, H, of the second surface 19 above the first surface 15 is preferably about 0.178 to 0.188 inch. More importantly, the height, H, is greater than the depth, D, of a generally complementary shaped socket 23 in the cemented tungsten carbide-cobalt tip 3 so that when the protrusion 17 is brazed to the socket 23 the

thickness of the resultant braze joint will be smaller adjacent the second forwardly facing surface 19 than it is adjacent the annular forwardly facing surface 15.

In Figure 2, the foregoing is shown more
5 clearly. The cemented carbide tip 3 has an annular rearmost surface 25 facing the forward end 9 of the steel body, and more particularly, facing the annular forwardly facing surface 15 on the steel body. Located radially inside of, and forward of, annular rearward facing
10 surface 25 is a second rearwardly facing surface 27. Both surfaces 25 and 27 are preferably planar in nature and preferably lie in a plane perpendicular to longitudinal axis X-X. Preferably located between, and preferably joining, the two rearwardly facing surfaces 25
15 and 27 is an inwardly facing surface 29 extending forwardly from the annular rearmost surface 25 while tapering inwardly, or preferably of frustoconical shape. The depth, D, of the socket 23 defined by surfaces 27 and 29 is preferably between 0.170 to about 0.176 inch, but
20 more importantly, the depth, D, of the socket is less than the height, H. The socket and protrusion have been sized such that, in the absence of braze metal, the tip can be seated on the surface 19 of the steel body without touching surface 15 of the steel body.

25 This results in a braze joint 7 which has an average thickness, T_1 , between the annular rearwardly facing surface 25 of the tip and the annular forwardly facing surface 15 of the steel body which is greater than the average thickness, T_2 , between rearwardly facing
30 surface 27 of the tip and forwardly facing surface 19 of the ferrous body. Thickness, T_1 , is preferably between about 0.008 to 0.024 inch, and more preferably, between about 0.010 to 0.016 inch thick. Thickness, T_2 , is preferably between about 0.001 to 0.006 inch, and more
35 preferably, between about 0.002 to 0.004 inch thick. The preferred average braze joint thickness, T_3 , between the inwardly tapering surfaces 29 and 21 on the tip socket

and the steel body protrusion 17 are also between about 0.008 to 0.024 inch, and more preferably, between about 0.010 and 0.016 inch. Preferably, T_1 and T_3 are each at least twice T_2 and, more preferably, at least three times T_2 .

5 In order to substantially maintain the uniformity of the braze joint thickness, T_3 , around the circumference of the protrusion surface 17, it is preferred that protruding means in the form of a
10 plurality of first dimples 31 be located between the tip 3 and the body forward end 9. Preferably, the first dimples 31 are provided on the rearward end of the tip 3, being formed on and protruding from the inwardly tapering surface 29 thereof for engaging the tapering surface 21
15 on the ferrous body protrusion. In such manner, the first dimples 31 place the tip 3 in a spaced, centered relationship relative to the ferrous body protrusion for facilitating formation therebetween of the braze joint 7 having the above-described cross-sectional thickness
20 profile. Thus, the first dimples 31 are preferably a part of the tip 3, extend radially inwardly from the inwardly tapering surface 29 of the tip socket, and are circumferentially distributed on this surface. Preferably, there are three of the first dimples 31
25 located at 120 degrees to each other. These are more clearly shown in the Figure 3 rear plan view of the tip.

Also, as seen in the embodiment of Figs. 6-8, it is desirable to provide a plurality of second dimples 32 in the protruding means. Ordinarily, the first dimples
30 31 will establish a positive spaced relationship between the tip 3 and body 9 which ensures the desired thickness profile along the braze joint 7. However, the first dimples 31 are subject to cocking and misalignment due to inaccurate placement of the tip 3 on the body 9 or due to
35 the existence of out-of-tolerance conditions of portions of any of the facing surfaces of the tip or body. These second dimples 32 are provided to compensate for such

contingencies. The second dimples 32 are formed on and protrude from the rearmost facing surface 25 for placing the tip 3 on the ferrous body end 9 in an aligned and spaced relationship thereto such that their respective axes generally coincide. Preferably, the second dimples are four in number and, as seen in Fig. 7, are circumferentially spaced approximately 90 degrees from each other.

The size of the first and second dimples 31, 32 should be such that, while they assist in assuring substantial uniformity of the braze thickness, T_3 , they are not so large as to interfere with the maintenance of the required relationships between the braze thicknesses, T_1 , T_2 and T_3 . Spherical shape dimples are preferred. Dimples 31 should have a height of about 0.005 to 0.008 inch above surface 29 to maintain the requirement that T_2 is less than T_3 . By assuring that the foregoing relation exists between T_2 and T_3 , it is believed that tip fracture in use will be minimized while providing a strong, long-lived joint between the tip of the steel body, thereby minimizing tip loss.

In an alternative embodiment (not shown), the annular surfaces 25 and 15 on the tip and steel shank, respectively, may be tilted rearwardly as they extend radially outwardly from the longitudinal axis X-X to thereby form frustoconical surfaces. In such a case, the angle of tilt is less than that of surfaces 21 and 29 and is preferably no greater than 30 degrees from a plane perpendicular to the longitudinal axis X-X. In this embodiment, the depth, D , may be calculated from a plane defined by the rearmost edge of surface 25 which occurs where it meets cylindrical surface 65 (see Figure 4). To be consistent, the height, H , of the steel protrusion in this situation would be calculated from a plane defined by where surface 15 intersects diameter D_{R3} , the outer diameter of tip surface 65 (see Figure 4).

It is further preferred that a high temperature

braze material be used in joining the tip to the ferrous body so that braze joint strength is maintained over a wide temperature range. Preferred braze materials are Handy Hi-temp 548, Trimet 549, 080 and 655. Handy Hi-temp-548 alloy is composed of 55 +/- 1.0 w/o (weight percent) Cu, 6 +/- 0.5 w/o Ni, 4 +/- 0.5 w/o Mn, 0.15 +/- 0.05 w/o Si, with the balance zinc and 0.50 w/o maximum total impurities. The Handy Hi-temp-Trimet 549 is a 1-2-1 ratio Trimet clad strip of Handy Hi-temp 548 on both sides of copper. Further information on Handy Hi-temp 548 and Trimet 549 can be found in Handy & Harman Technical Data Sheet Number D-74. The foregoing braze alloys are manufactured and sold by Handy & Harman Inc., 859 Third Avenue, New York, NY 1002. Handy Hi-temp and Trimet are registered trademarks of Handy & Harman Inc.

Applicants have found that acceptable braze joints have been achieved by using Handy Hi-temp-549 discs which have been shaped into cups, fitted between the socket of the tip and the protrusion of the ferrous body and then brazed by conventional induction brazing techniques which, in addition to brazing the tip to the steel body, also hardens the steel which may be any of the standard steels used for rotatable cutter bit bodies. After the brazing and hardening step, the steel is tempered to a hardness of Rockwell C 40-45. The cemented carbide tip may be composed of any of the standard tungsten carbide-cobalt compositions conventionally used for construction and excavation applications. Applicants have found that acceptable results in asphalt reclamation have been achieved with a standard tungsten carbide grade containing about 5.7 w/o cobalt and having a Rockwell A hardness of about 88.2.

The earth engaging surfaces of the tip may have any of the conventional sizes or shapes previously used in the art. However, a preferred design is shown in Figures 1-5 (and also in Figures 6-8). In the design shown, the forward end of the earth engaging surfaces has

a spherical nose 45 having a radius R_T , joined to a frustoconical surface 50 tapering away from the rotational axis of symmetry, X-X, as it extends rearwardly at an angle $90-A_T$, to form a maximum diameter, D_F at a distance L_2 from the forward end of nose 45. Joined to frustoconical surface 50 is a bell shaped section 55 having an earth engaging concave surface 60 at whose rear end is joined a uniform diameter protective surface 65. The concave surface is formed by a series of concave surfaces 60A, 60B and 60C, each having a different radius of curvature and wherein the radii decrease as one moves rearwardly along the length of the tip (i.e., $60A > 60B > 60C$). While any number of radii, R_N , or arcs, A_N , may be used, it is preferred that at least three radii (or arcs) be used to form the smooth continuous surface 60, here shown as R_1 , R_2 and R_3 , and A_1 , A_2 and A_3 . The rear end of the concave surface 60 joins cylindrical surface 65 which preferably has a diameter D_{R3} which is not only greater than D_F , but is of sufficient size to completely, or at least substantially cover the entire forward surface of the steel body to which the tip is brazed (i.e., more than 98% of the forward surface diameter). Maximum protection from wear to the forward end of the steel shank is thereby provided by the cemented carbide tip, thus reducing the rate of wear on the forward end 9 of steel body.

The use of the concave surface 60 of variable radius as shown allows a tip to be manufactured having increased length L_1 while assuring maximum strength and a substantially even distribution of stresses during use to thereby minimize tip fracture in use.

The internal diameters of the socket D_{R1} and D_{R2} , and its shape, can be selected to provide a substantially uniform wall surface, especially in the zone of the concave section 60. The flat circular surface 27 at the forward end of the socket provides a large area for brazing to the forward end surface of the

protrusion on the steel body. This structure, in combination with the thin braze joint thickness at this location, provides assurance that, during use, most significant loads applied to the tip will place the tip in compression rather than tension. Examples of dimensions which applicants have found to be acceptable are shown in Table I. These dimensions should be used with the previously provided dimensions relating to the tip socket, steel protrusion and braze joint thicknesses.

TABLE I

EXEMPLARY TIP DIMENSIONS

Attribute	Radius (inch)	Diameter (inch)	Angle (degree)	Length (inch)
R ₁	1.179			
R ₂	1.047			
R ₃	0.363			
A ₁			3.708	
A ₂			11.630	
A ₃			53.672	
R _T	0.125			
A _T			50	
L ₁				0.693
L ₂				0.184
L ₃				0.070
D _F		0.425		
D _{R1}		0.285		
D _{R2}		0.531		
D _{R3}		0.750		

All patents and documents referred to herein are hereby incorporated by reference.

As is well known to those of ordinary skill in the art, at the junctures of the various surfaces described on the carbide tip, chamfers, fillets and/or pressing flats may be provided, where appropriate, to assist in manufacturing and/or provide added strength to the structure.

Figures 9 and 10 illustrate respective modified embodiments of the tip 3A and body 5A of the cutter bit. These embodiments of the tip 3A and body 5A are only slightly modified from the embodiments of the tip 3 and body 5 of Figures 2 and 6, so only the differences between the two will be described. The respective outwardly facing surface 21 on the protrusion 17 of the body 5 and the inwardly facing surface 29 on the socket 23 of the tip 3 in Figures 2 and 6 are frustoconical in shape; in contrast thereto, the corresponding surfaces 21A and 29A on the respective protrusion 17A and socket 23A of the body 5A and tip 3A are respectively concave and convex in shape. The convex surface 29A on the tip socket 23A has a radius R_4 equal to approximately 0.487 inch and is concentric with the radius R_3 on the outside surface 55A of the tip 3A. The radius R_3 is the same as before. Additionally, the radius R_5 at the transition 67 between the convex surface 29A and the surface 27 is equal to about 0.12 inch. The concave surface 21A on the body protrusion 17A and the transition 69 between the concave surface 21A and the surface 19 complement those of the tip socket 23A. The modification of the configuration of the socket 23 of tip 3 (Figures 2 and 6) having the frustoconical surface 29 to the configuration of the socket 23A of the tip 3A (Figure 9) having the convex surface 29A provides a more uniform thickness in the annular section of the tip surrounding the socket thereby strengthening the material of the tip in this section. The first dimples 31 are now formed on and protrude from the inwardly facing convex surface 29A of the tip socket 23A for engaging the outwardly facing concave surface 21A on the body protrusion 17A.

Other embodiments of the invention will be apparent to those skilled in the art from a consideration of this specification or practice of the invention disclosed herein. It is intended that the specification and examples be considered as exemplary only, with the

true scope and spirit of the invention being indicated by the following claims.

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WHAT IS CLAIMED IS:

1. A cemented carbide tip comprising:
a forward end for engaging an earth formation;
5 a rearward end for attachment to an end of a
ferrous metal body;
said tip being rotationally symmetric about a
longitudinal axis extending from said forward end to said
rearward end;
10 said rearward end having an annular rearwardly
facing outer surface and an inner socket extending
forwardly therefrom and being shaped to fit with a
protrusion on the ferrous body end; and
means protruding from said rearward end on at
15 least one of said outer surface and inner socket thereof
for engaging the ferrous body end and placing said tip in
a spaced relationship relative thereto for facilitating
formation therebetween of a braze joint having a
predetermined cross-sectional thickness profile.
20
2. The cemented carbide tip according to
Claim 1 wherein said protruding means includes a
plurality of first dimples formed on said inner socket of
said rearward end and being spaced from one another.
25
3. The cemented carbide tip according to
Claim 2 wherein said inner socket includes an inwardly
and radially facing surface and said first dimples are

formed on said inwardly and radially facing surface.

4. The cemented carbide tip according to Claim 3 wherein inwardly and radially facing surface is frustoconical in shape.

5. The cemented carbide tip according to Claim 3 wherein said inwardly and radially facing surface is convex in shape.

6. The cemented carbide tip according to Claim 2 wherein said plurality of first dimples are three in number being circumferentially spaced approximately 120 degrees from each other.

7. The cemented carbide tip according to Claim 2 wherein said protruding means includes a plurality of second dimples formed on said outer surface of said rearward end and being spaced from one another.

8. The cemented carbide tip according to Claim 7 wherein said plurality of second dimples are four in number being circumferentially spaced approximately 90 degrees from each other.

9. The cemented carbide tip according to Claim 1 wherein said protruding means includes a plurality of second dimples formed on said outer surface of said rearward end and being spaced from one another.

10. The cemented carbide tip according to Claim 9 wherein said plurality of second dimples are four in number being circumferentially spaced approximately 90 degrees from each other.

11. A cemented carbide tip comprising:
a forward end for engaging an earth formation;

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a rearward end for attachment to an end of a ferrous metal body;

said tip being rotationally symmetric about a longitudinal axis extending from said forward end to said rearward end;

said rearward end having an annular rearwardly facing first surface, a rearwardly facing second surface located inside and forwardly of said first surface, and an inwardly and radially facing third surface separating said first and second surfaces; and

means protruding from said rearward end on at least one of said first and third surfaces for engaging the ferrous body end and placing said tip in a spaced relationship relative thereto for facilitating formation therebetween of a braze joint having a predetermined cross-sectional thickness profile.

12. The cemented carbide tip according to Claim 11 wherein said protruding means includes a plurality of first dimples formed on said third surface and being spaced from one another for placing said tip on the ferrous body end in a centered and spaced relationship thereto.

13. The cemented carbide tip according to Claim 12 wherein third surface is frustoconical in shape.

14. The cemented carbide tip according to Claim 12 wherein said third surface is convex in shape.

15. The cemented carbide tip according to Claim 12 wherein said plurality of first dimples are three in number being circumferentially spaced approximately 120 degrees from each other.

16. The cemented carbide tip according to Claim 12 wherein said protruding means includes a

plurality of second dimples formed on said outer surface of said rearward tip end and being spaced from one another for placing said tip on the ferrous body end in an aligned and spaced relationship thereto.

5

17. The cemented carbide tip according to Claim 16 wherein said plurality of second dimples are four in number being circumferentially spaced approximately 90 degrees from each other.

10

18. The cemented carbide tip according to Claim 11 wherein said protruding means includes a plurality of second dimples formed on said outer surface of said rearward tip end and being spaced from one another for placing said tip on the ferrous body end in an aligned and spaced relationship thereto.

15

19. The cemented carbide tip according to Claim 18 wherein said plurality of second dimples are four in number being circumferentially spaced approximately 90 degrees from each other.

20

20. The cemented carbide tip according to Claim 11 wherein third surface is frustoconical in shape.

25

21. The cemented carbide tip according to Claim 11 wherein said third surface is convex in shape.

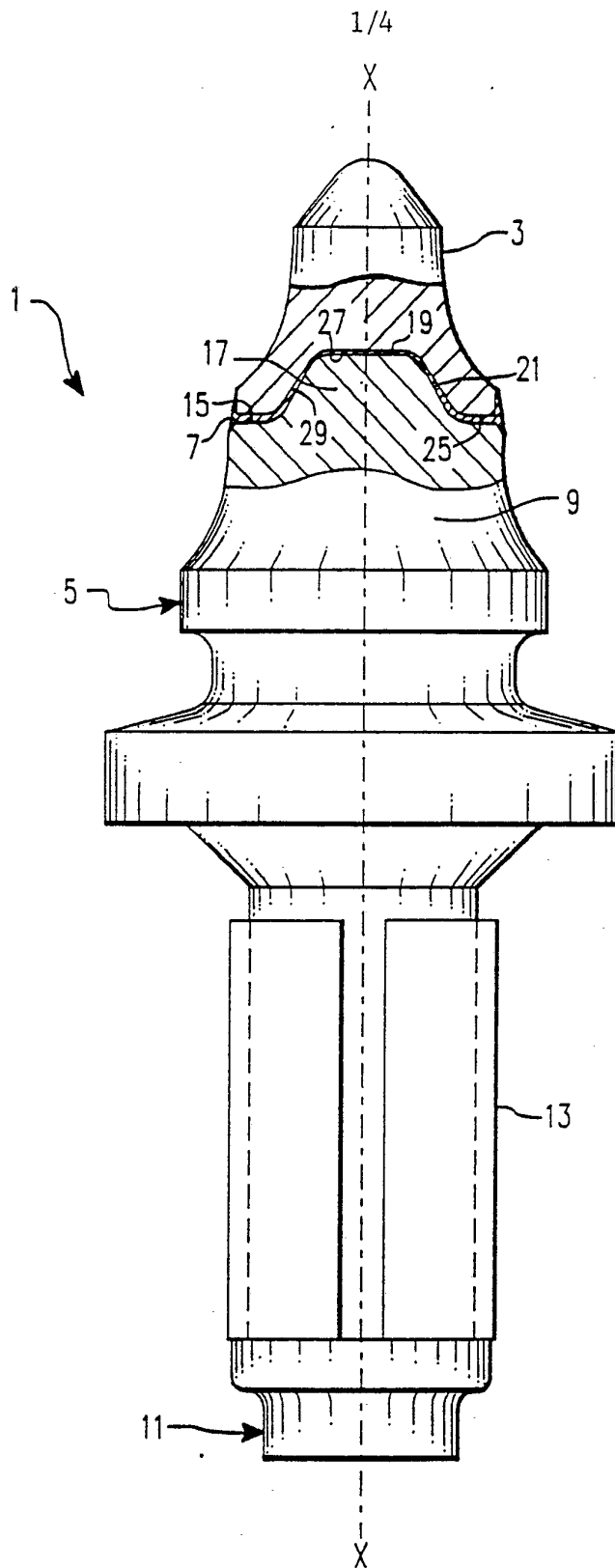


FIG. 1

FIG. 2

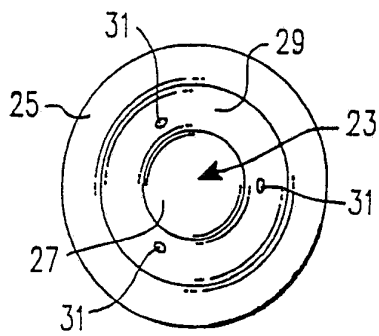
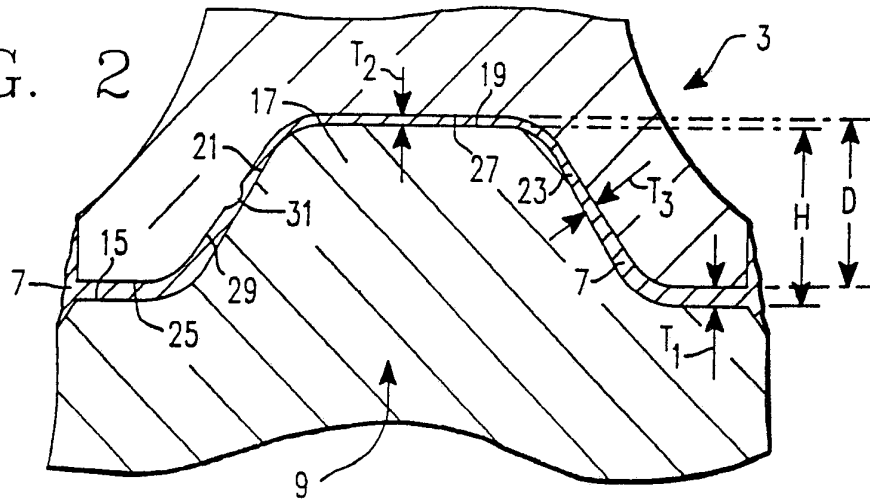


FIG. 3

FIG. 4

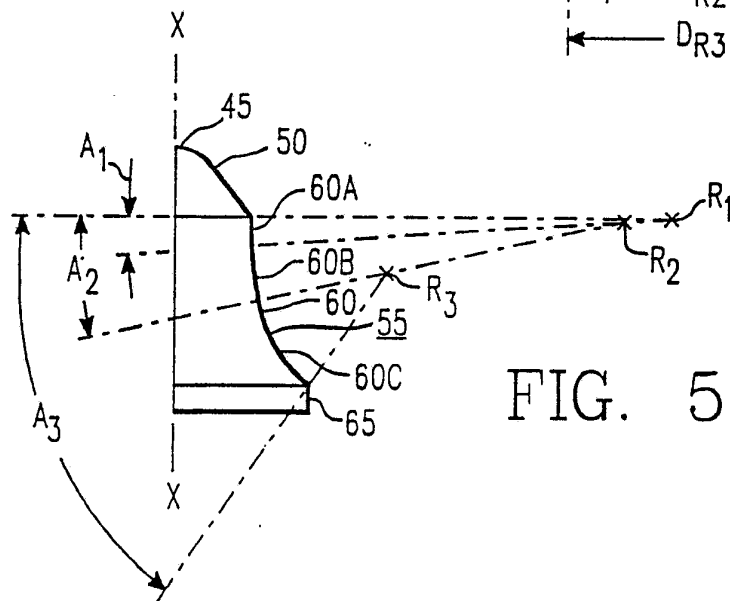
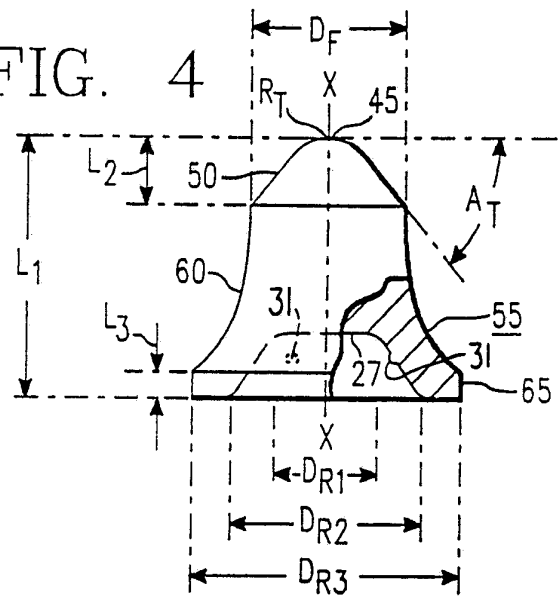


FIG. 5

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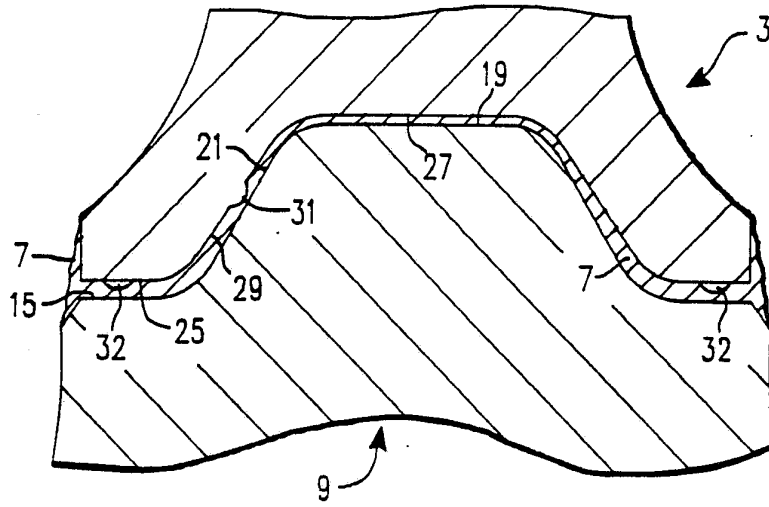


FIG. 6

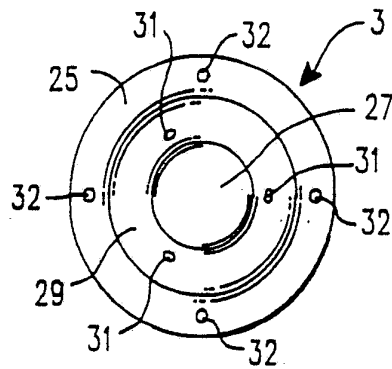


FIG. 7

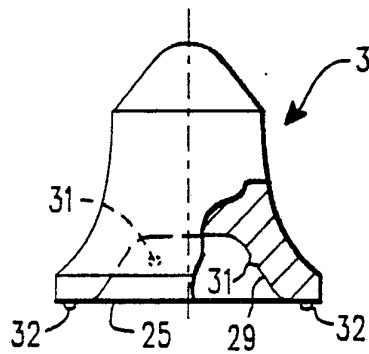


FIG. 8

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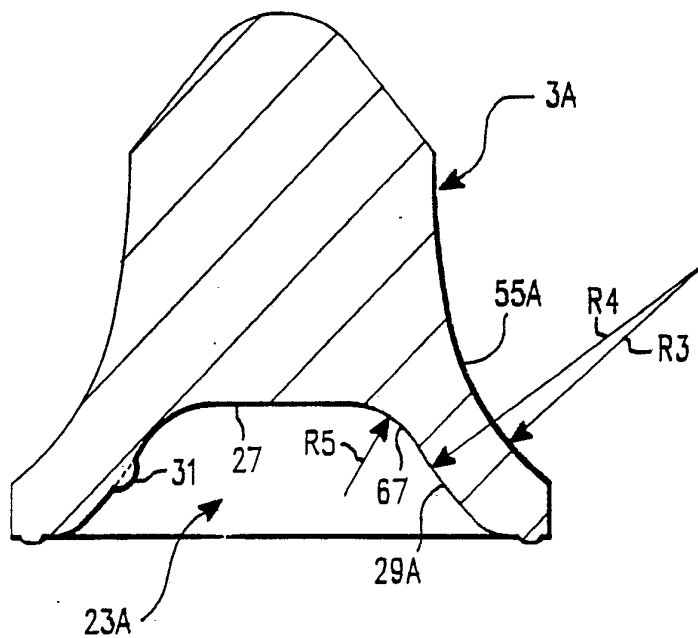


FIG. 9

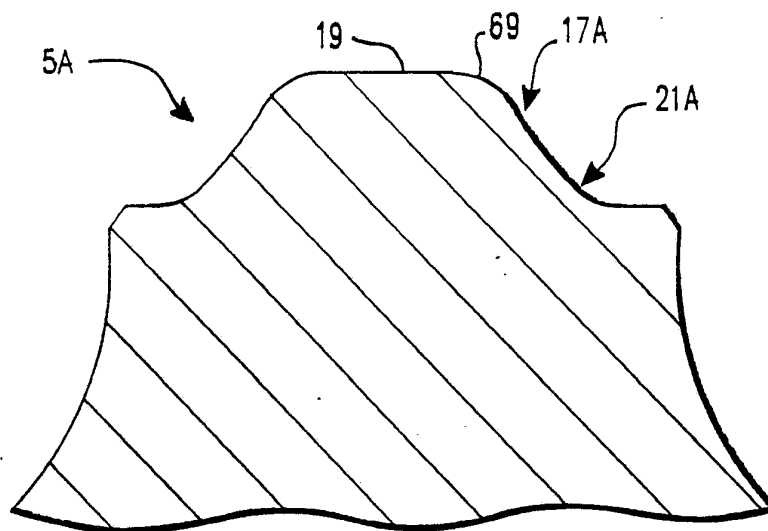
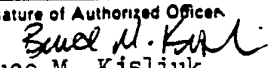


FIG. 10

INTERNATIONAL SEARCH REPORT

International Application No. **PCT/US89/03057**

I. CLASSIFICATION OF SUBJECT MATTER		
According to International Patent Classification: IPC Class. and National Classification and IPC IPC (4): E21C 35/18 U.S. Cl. 299/91; 172/713, 745; 175/410, 411; 407/118		
I. FIELDS SEARCHED		
Minimum Documentation Searched *		
Classification System	Classification Symbols	
U.S.	299/79, 86, 91; 175/409-411, 374, 375; 51/309; 76/101E, 108A, 108R, DIG.5, DIG.11; 407/118; 172/713, 745	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched *		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹		
Category ¹	Citation of Document, with indication, where appropriate, of the relevant passages ²	Relevant to Claim No. ³
Y	SE, B, 8400269-0 (LUNDELL ET AL) 10 DECEMBER 1984, see entire document.	1-4, 6, 11-13, 15,20
Y	GB, A, 372,252 (BRITISH THOMSON-HOUSTON CO.) 05 MAY 1932, see entire document.	1-4, 6, 11-13, 15,20
Y	SU, A, 781,341 (AS UKR HARD MATER) 23 NOVEMBER 1980, see entire document.	5, 14, 21
A	US, A, 2,784,943 (BYLUND) 12 MARCH 1957, see column 1, lines 19-67.	
A	SU, A, 402,655 (KARABANOV ET AL) 02 APRIL 1974, see entire document.	
A	US, A, 2,707,619 (ANDERSSON) 03 MAY 1955, see entire document.	
<p>* Special categories of cited documents: ¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"Δ" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
29 AUGUST 1989	02 OCT 1989	
International Searching Authority	Signature of Authorized Officer	
ISA/US	 Bruce M. Kisliuk	