

# United States Patent

**[[11]] 3,603,414**

[72] Inventor **Frank E. Stebley**  
3815 Nemesis Ave., Gurnee, Ill. 60031

[21] Appl. No. 7,135

**[22] Filed Jan. 30, 1970**

[45] Patented Sept. 7, 1971

*Primary Examiner—David H. Brown*  
*Attorney—John S. O'Brien*

**[54] INSERT FOR DRILLING UNIT**  
**17 Claims, 9 Drawing Figs.**

[52] U.S. Cl..... 175/374,  
175/410

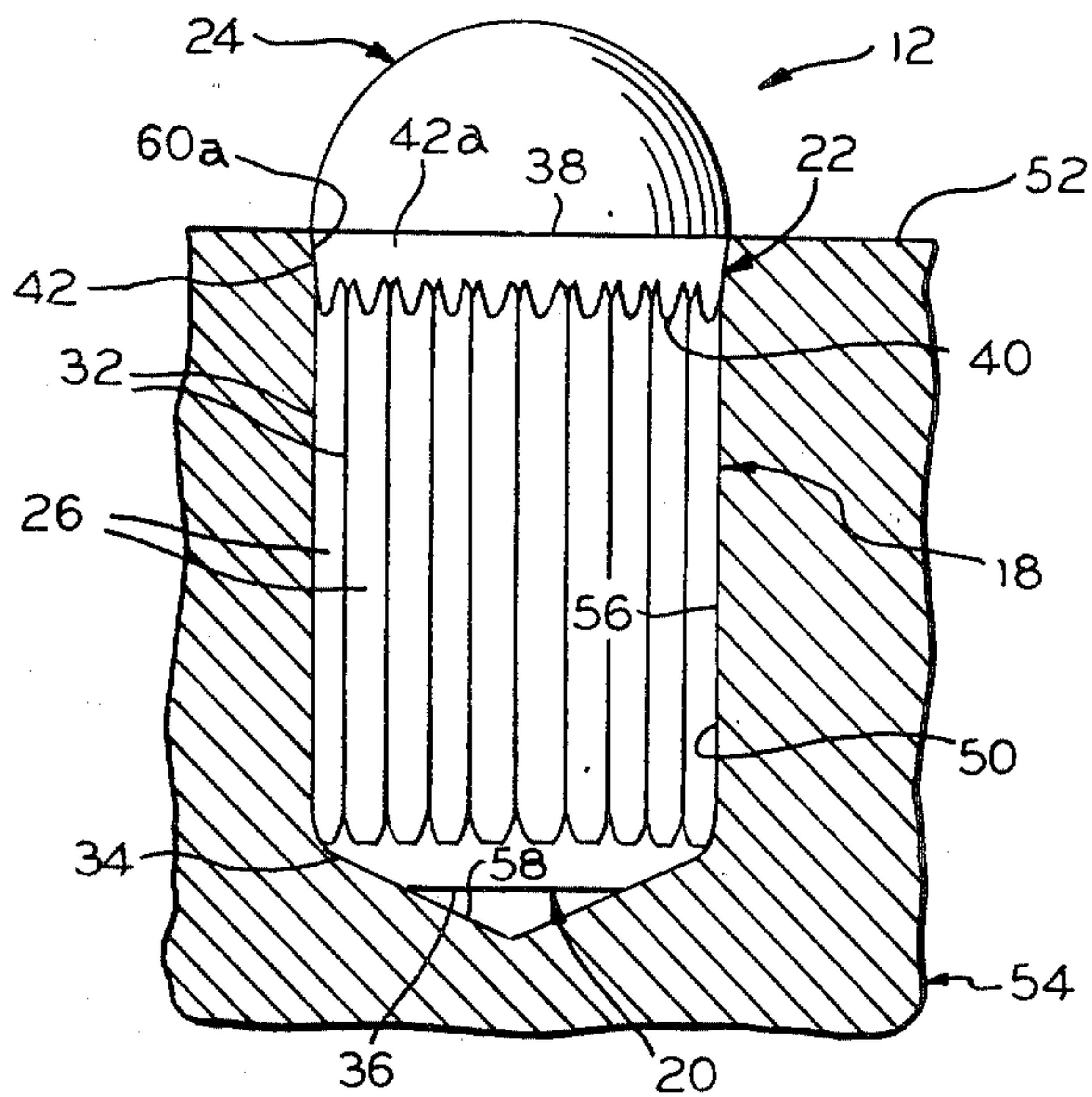
[51] Int. Cl. .... E21c 13/01,  
E21c 13/06

[50] **Field of Search**..... 175/374,  
375, 409, 410

[56] **References Cited**  
**UNITED STATES PATENTS**

2,121,202	6/1938	Killgore.....	175/374
2,687,875	8/1954	Morlan et al. ....	175/374
2,955,804	10/1960	Feucht .....	175/409
3,027,953	4/1962	Coski .....	175/409
3,311,181	3/1967	Fowler .....	175/410
3,356,418	12/1967	Healey et al. ....	175/410 X
3,382,940	5/1968	Stebley.....	175/410
3,389,761	6/1968	Ott .....	175/374

**ABSTRACT:** A solid wear-resistant sintered metallic carbide insert adapted for forcible insertion into an opening in a working face of a drill member includes a generally polygonal body portion having at least about 12 sides extending between a base end and an opposite head end thereof, and a generally conical wedging portion on the head end of the body portion diverging outwardly therefrom and having an outer diameter greater than the diameter of the body portion, the wedging portion intersecting the body portion whereby the corners formed by the body portion sides terminate intermediate the outer and inner ends of the wedging portion to provide a smooth annular wedging surface on the outer end of the wedging portion, the body and wedging portions being insertable into the working face opening for mounting them therein with the body portion engaging the wall of the opening in an interference fit and the outer end of the wedging portion wedged in the opening adjacent the working face. A unit for drilling earth formations includes a drill member having a working face provided with a generally circular insert opening extending inwardly therefrom, the opening terminating at the working face in an outwardly divergent conical mouth, and the insert mounted in the opening with its body portion engaging the wall of the opening in an interference fit and the outer end of its wedging portion wedged in the mouth of the opening.



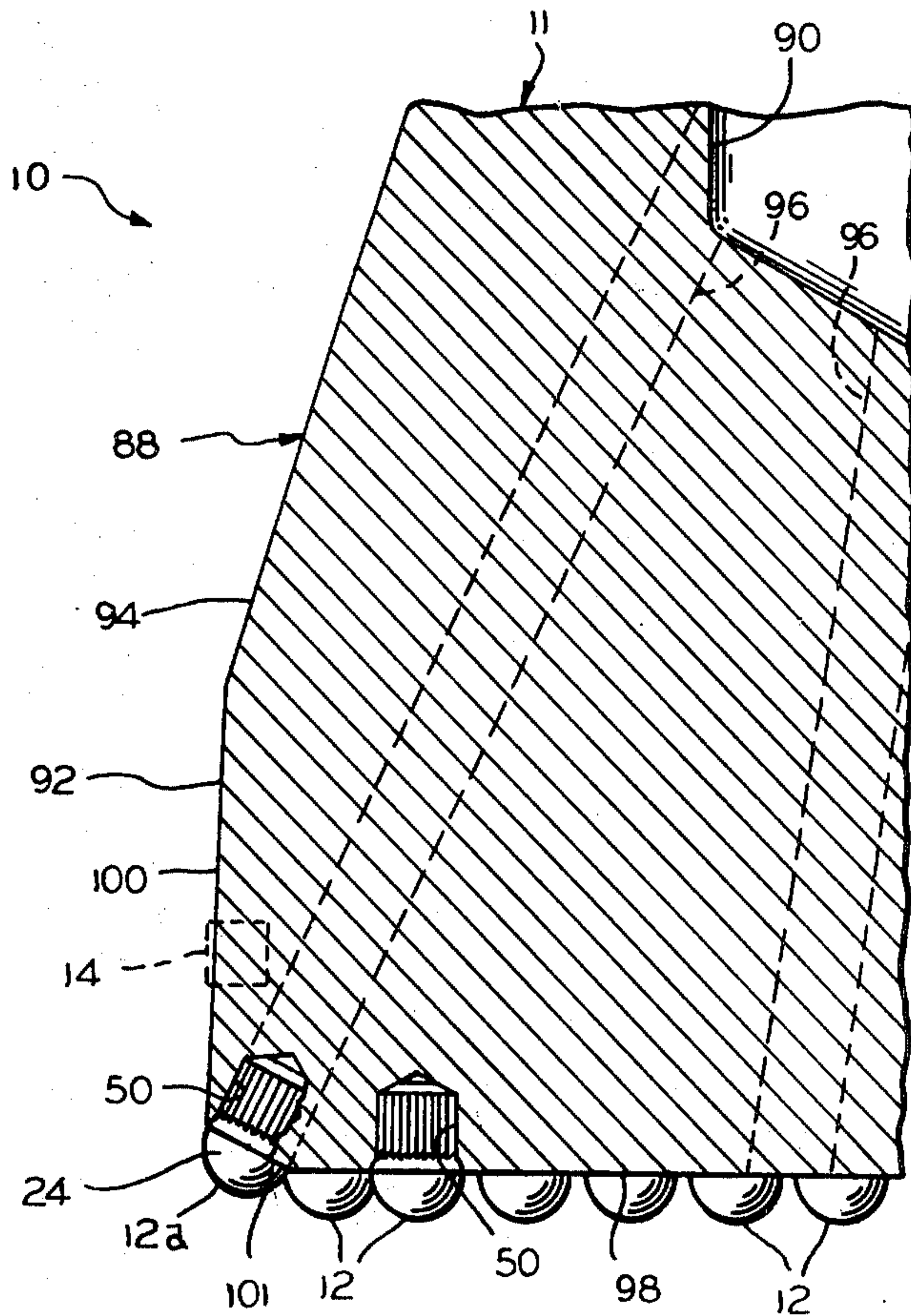


FIG. 1

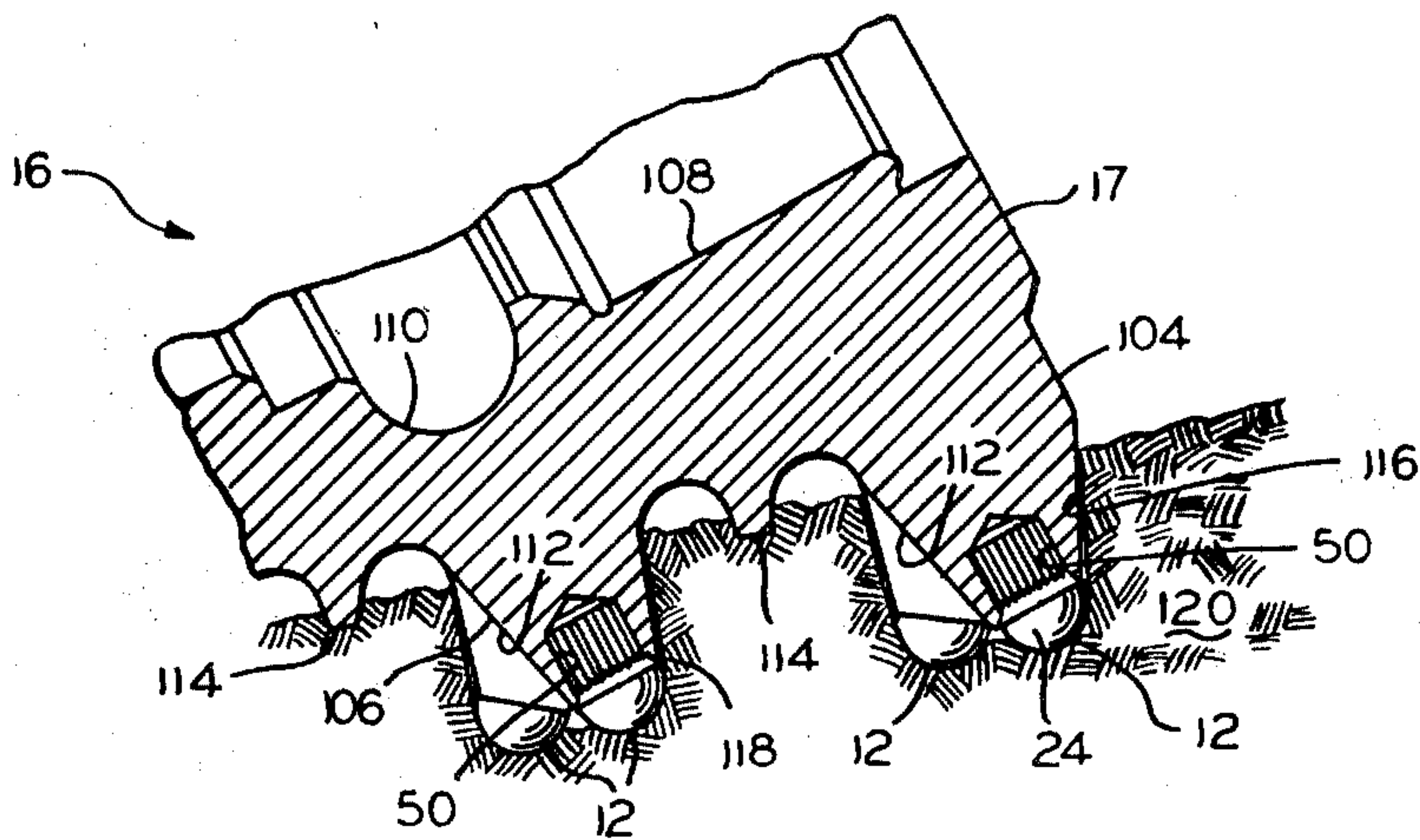


FIG. 2

INVENTOR  
FRANK E. STEBLEY

BY

*John S. O'Brien*

ATTORNEY



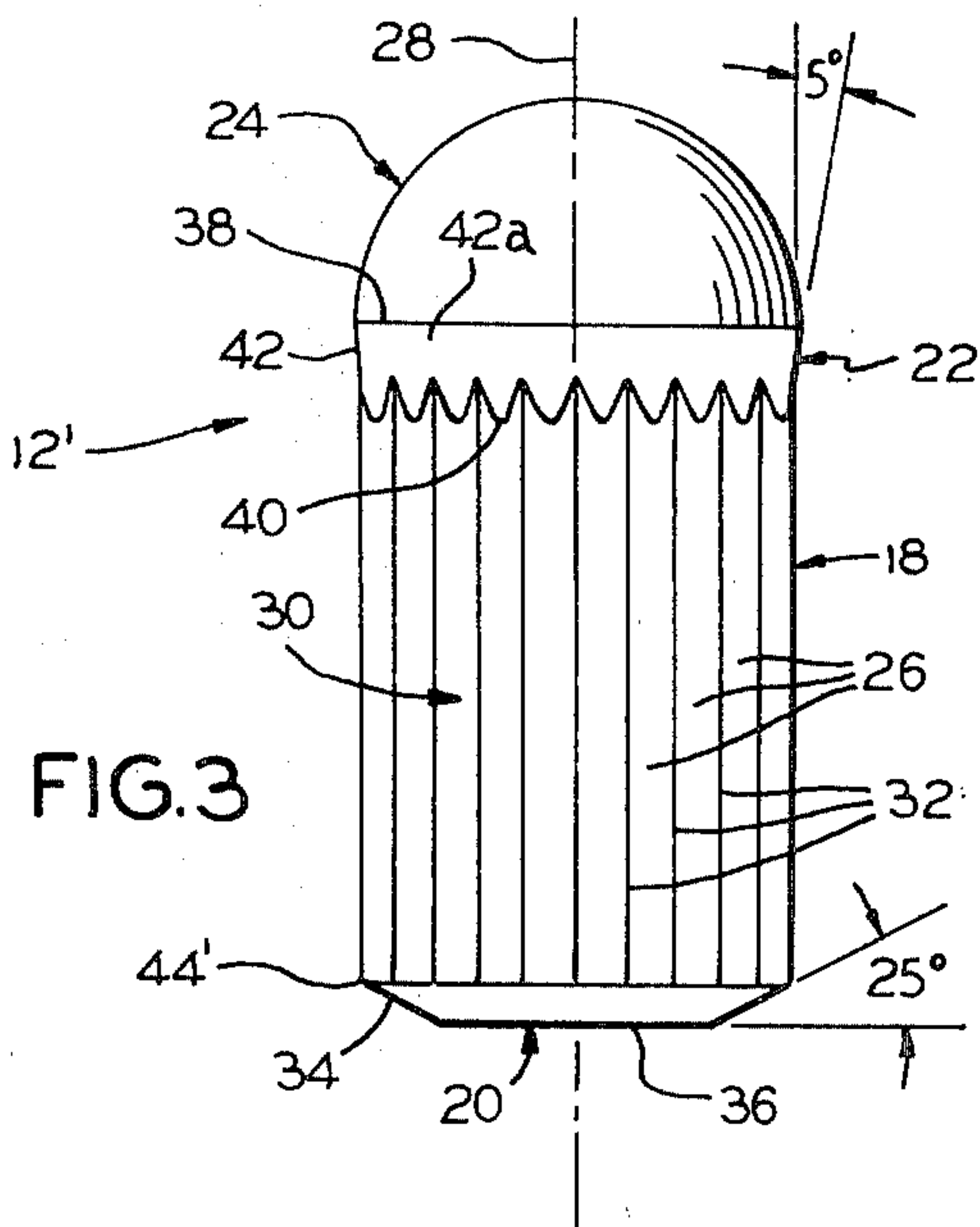


FIG. 3

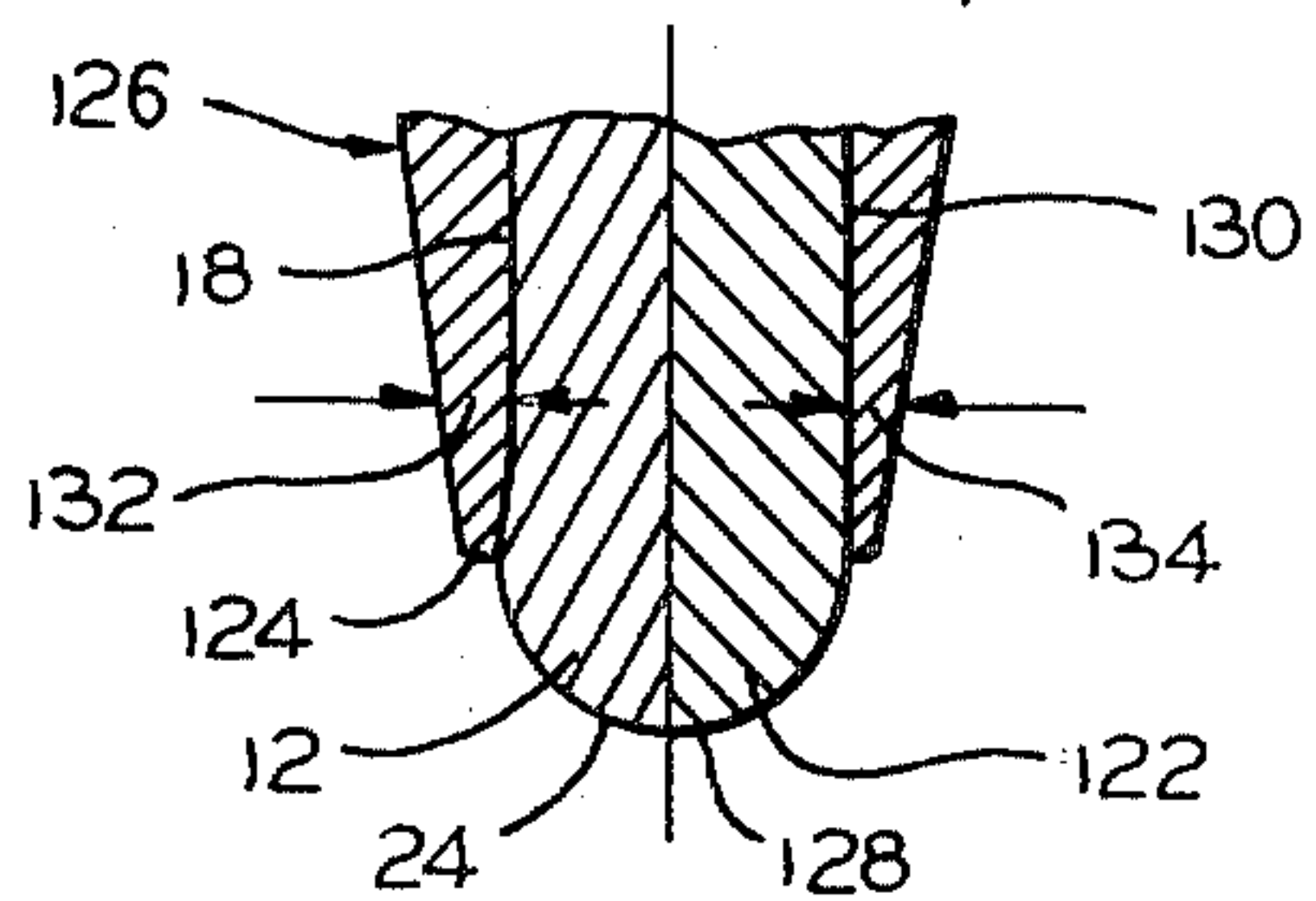


FIG. 6

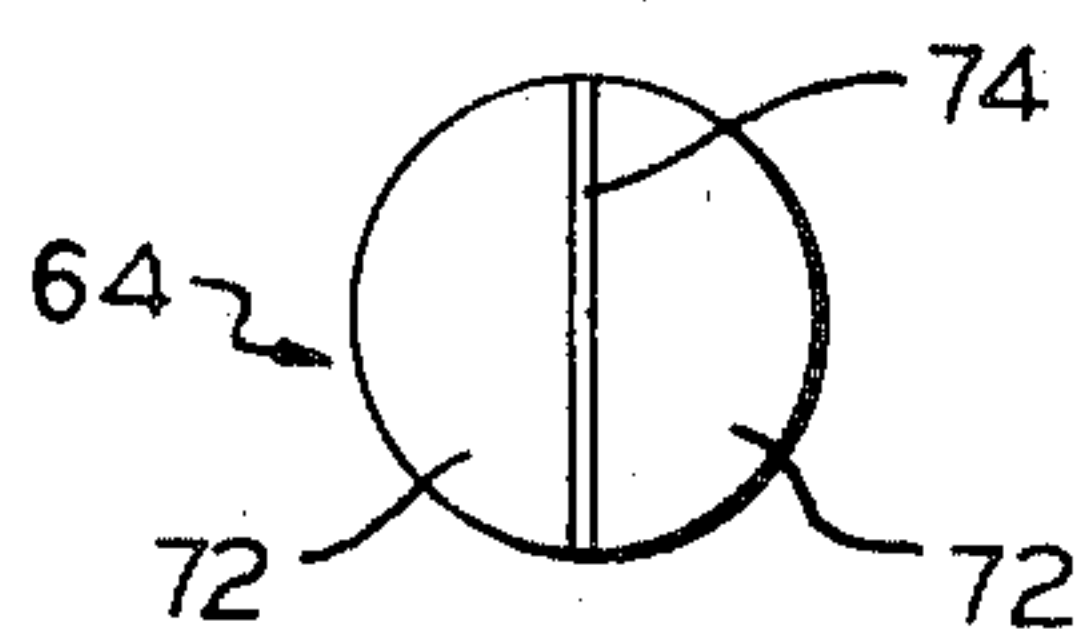


FIG. 8

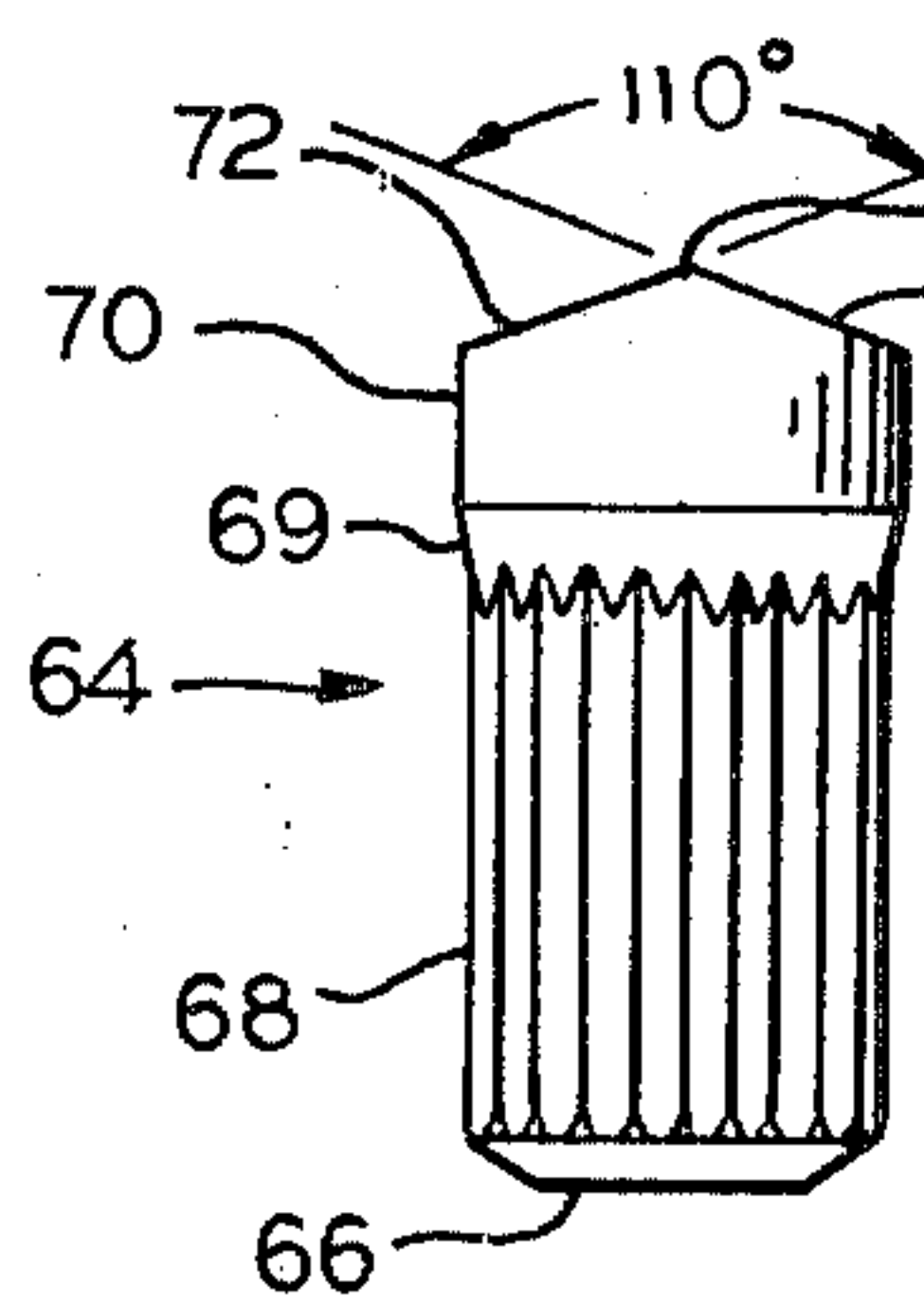


FIG. 7

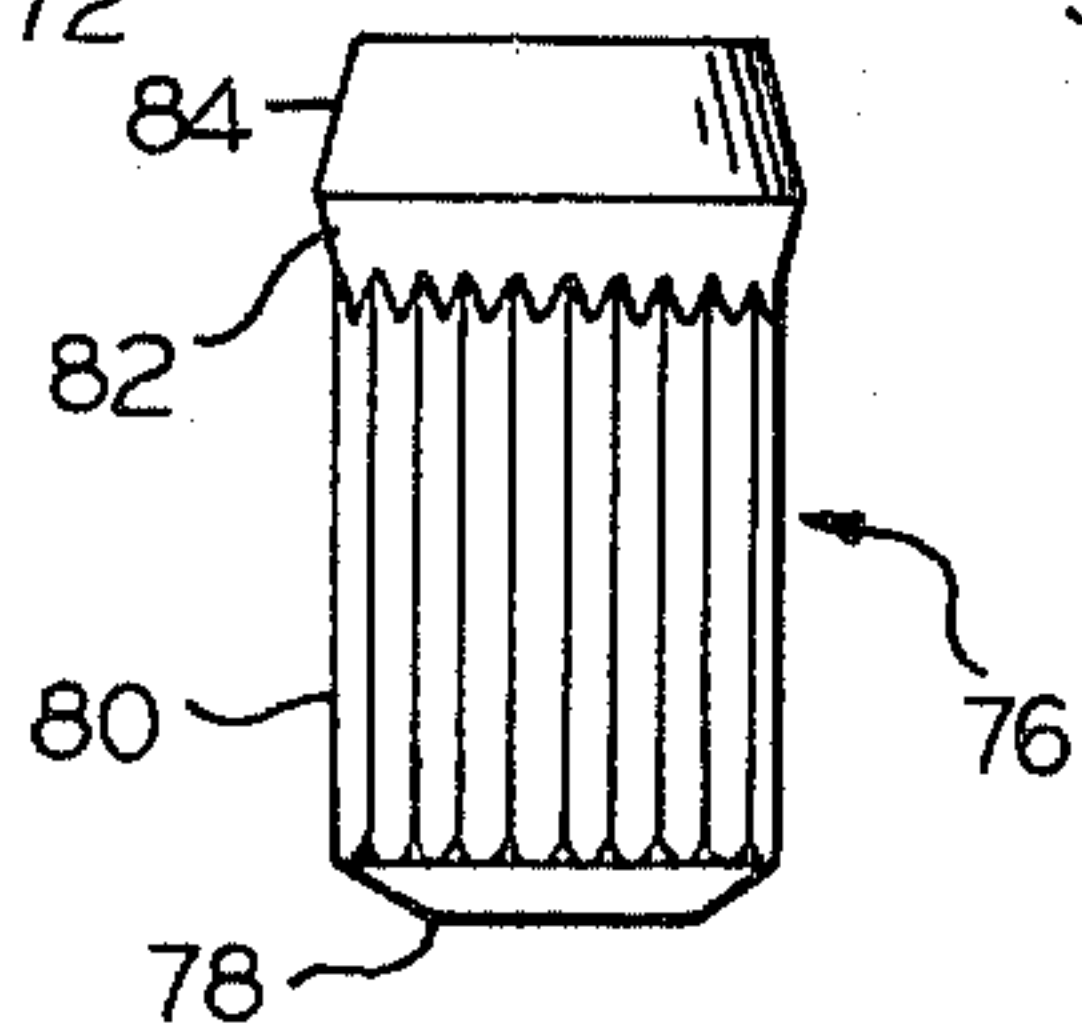


FIG. 9

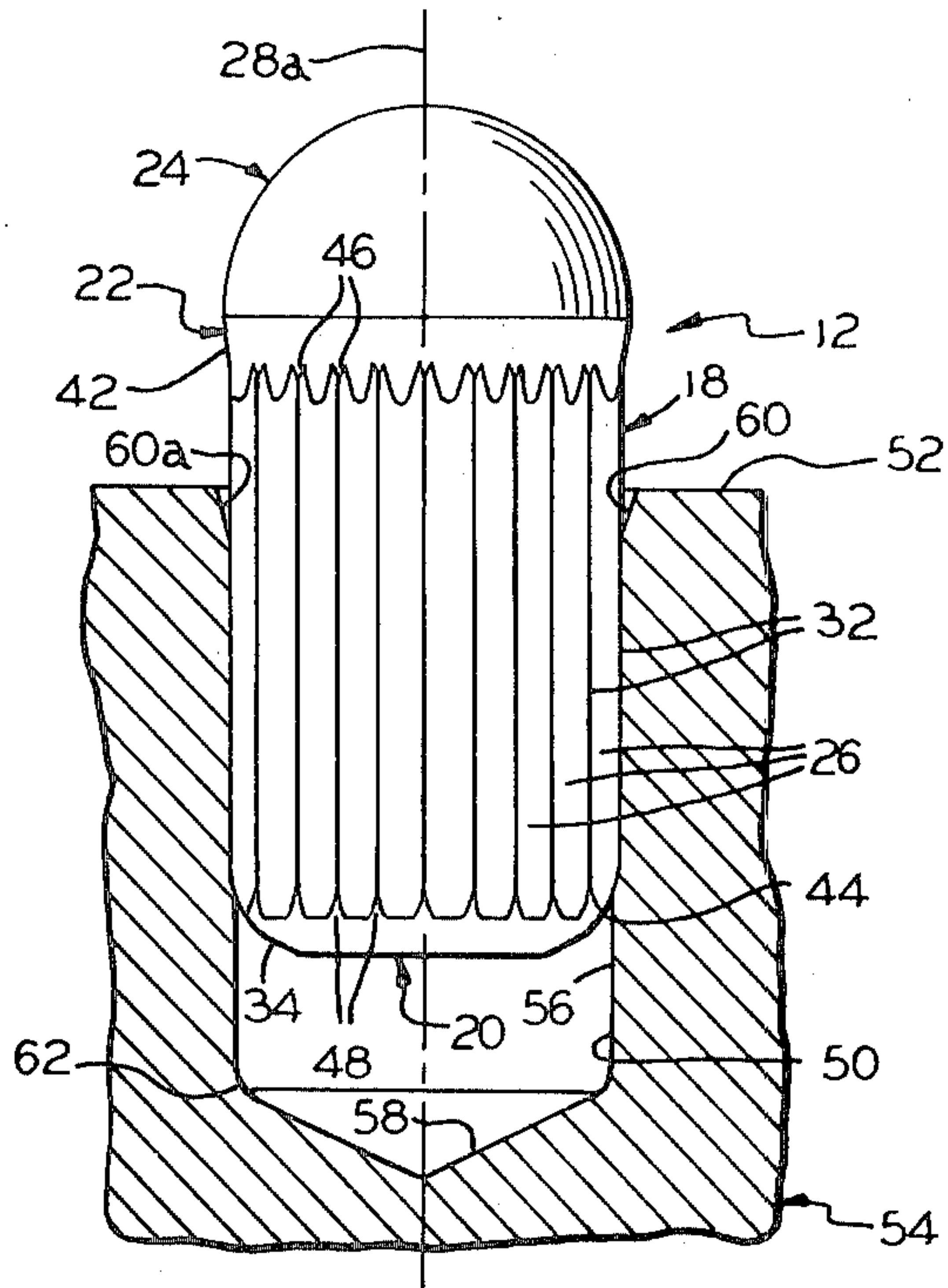


FIG. 4

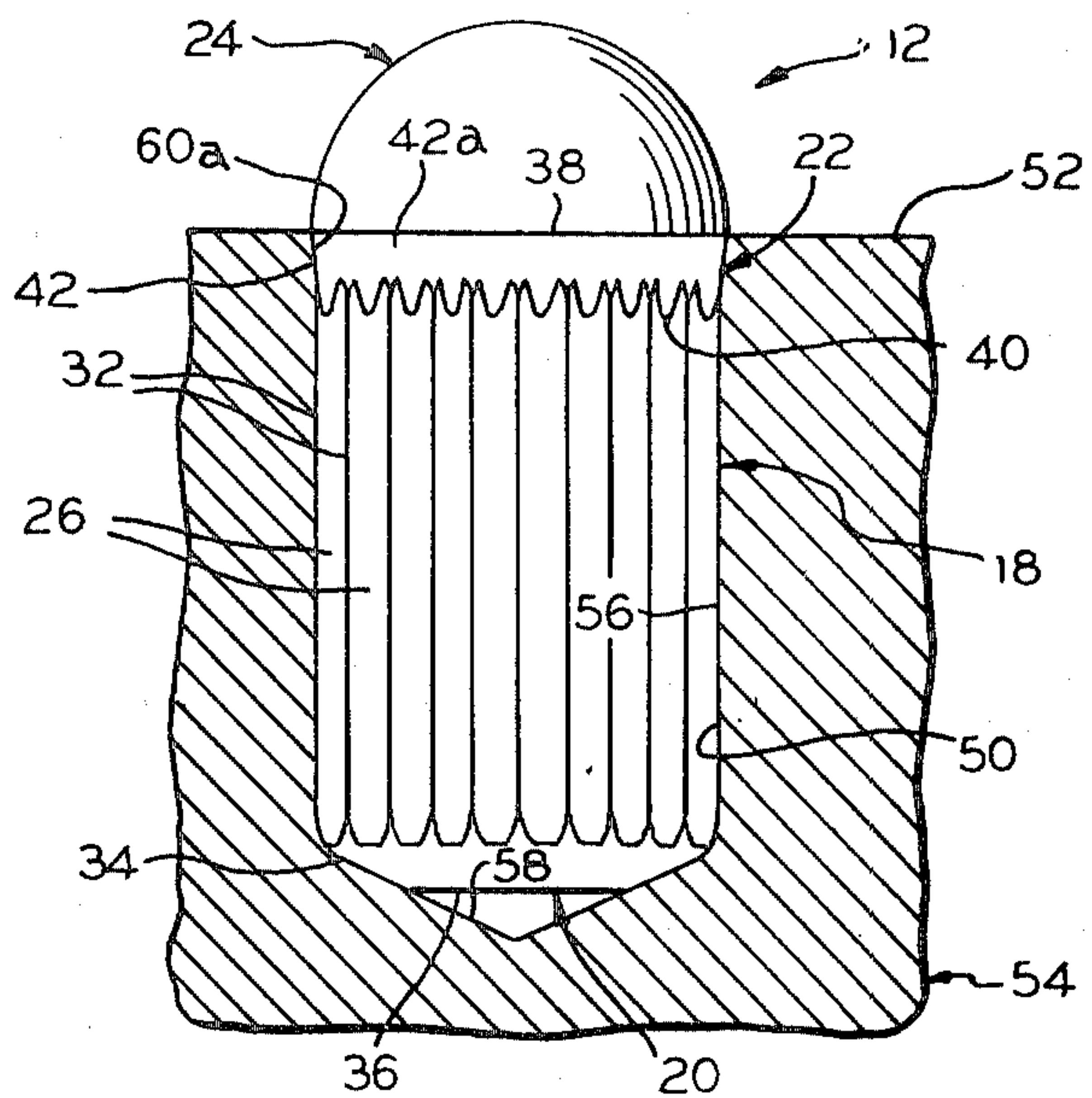


FIG. 5

INVENTOR  
FRANK E. STEBLEY

BY *John S. O'Brien*  
ATTORNEY



## INSERT FOR DRILLING UNIT

## BACKGROUND OF THE INVENTION

This invention relates to a solid wear-resistant sintered metallic carbide insert adapted for forcible insertion into an opening in a working face of a drill member and to a drilling unit of the insert and the drill member. More particularly, the invention relates to an insert which may be mounted more securely in a drill member with reduced insert fracture and loss in drilling.

Inserts or teeth of wear-resistant sintered metallic carbide are widely used in drill members of apparatus for drilling earth formations, especially for drilling into rock formations. Such inserts have much greater wearability than similar inserts constructed of steel. While hard and wear-resistant, the carbide inserts are also brittle and have poor resistance to bending. Consequently, the inserts have a tendency to break in use when not properly mounted in the drill members, and they may also be lost from the drill members. The inserts cannot be replaced in many drill members, so that it becomes necessary eventually to discard the entire drilling unit, which is very costly.

Drill members as contemplated in the invention include percussion-type drill bit bodies, and roller or rolling cutter bodies for rotary drilling apparatus, the latter including roller bits and drilling and tunneling machines and the like. The percussion drill bits are constructed of a solid steel body having a working face or faces at one end of the bit. Generally cylindrical inserts or teeth of sintered metallic carbide are mounted in openings in the working face and are exposed thereat. Roller cutters are constructed of steel bodies in various type configurations, such as cylindrical, conical, and disc types. Carbide inserts are mounted in openings in working faces provided on the cutter bodies, including cutting edges thereon. Inserts also are mounted in the drill bits and cutters in appropriate locations for minimizing wear of the drill member. The inserts are forcibly inserted into openings having slightly smaller diameters than the insert diameter, so that the inserts engage the walls of the openings in which mounted in an interference fit.

In manufacturing a suitable drill member, the steel structure usually is drilled to provide insert openings and then heat treated to a predetermined degree of hardness. The drilled holes then are precisely reamed to correct for heat distortion and drilling errors, and form insert openings or holes having the desired diameter and cylindrical configuration.

The carbide inserts are manufactured by molding metallic carbide powder under die pressure to form oversize molded articles. The molded articles are sintered to form solid sintered articles having the desired physical properties. Inasmuch as the molded articles are formed by compression between dies acting at opposite ends of the articles, the density or compression of the material in the molded articles varies from a maximum adjacent the ends to a minimum in the central region. The sintering step is accompanied by shrinkage, which increases towards the less dense central region, so that the resulting articles have generally concave sides. For example, the shrinkage in an insert of about  $\frac{5}{16}$ -inch diameter and about 1-inch length is generally about 0.003 to 0.004 inch at the center. Consequently, the inserts are ground to eliminate the concavity and provide cylindrical bodies of the desired diameter. Thereafter, the inserts may be tumbled in an abrasive medium to abrade or round off their corners.

The finished inserts are pressed into the openings in the working faces of the drill members to seat them firmly in the openings, with the outer ends or head portions of the inserts exposed at the working faces, from which they project for impacting and cutting action. Inserts provided for minimizing the wear of a drill member may lie flush with the face of the member or project lesser distances therefrom.

Owing to the brittle nature of the carbide inserts, they should be provided with maximum support by the drill member when mounted. With poor support, especially ad-

jacent the face of the drill member, the inserts are prone to fracture under transverse forces, and they may also work loose and fall out of the drill member.

Inasmuch as the resiliency of a steel drill member is limited, a portion of the compression or gripping force on the inserts may be lost during mounting. Consequently, careful insertion of the inserts into their openings is necessary, to avoid distortion of the openings which would reduce the compression. However, such distortion occurs nevertheless. Also, drilling errors survive the reaming operation, and they most frequently result in the insert openings having greater diameters at the top than at the bottom. The openings may be non-circular at the top, or suffer from a bell mouth condition. As a result of these imperfections, the inserts are gripped most securely at the bottom and to lesser degrees in the center and upper or outer areas. The inserts then are more prone to fracture in their openings and to loosening with eventual loss.

In order to minimize insert fracture and loss, insert manufacturers have in the past blunted the commonly hemispherical heads of the inserts, so that their outer ends lie closer to the working face. However, less free space than remained under the bit, restricting fluid flow for removing loose material from the bore hole. In order to increase the free space beneath the drill member, and also for added penetration of the inserts into soft formations, and for reducing wear on the drill member, the portions of the drill member surrounding the inserts were extended or built up beyond the working face for mounting the inserts so as to project further from the working face.

It would be highly advantageous to provide a wear-resistant sintered metallic carbide insert that may be mounted readily in a suitable opening in a working face of a drill member to provide maximum compressive or gripping force on the insert at the face of the drill member and secure mounting within the opening, and obviating prior mounting deficiencies due to improper insertion and imperfections in the size and shape of the opening as commonly encountered in practice. It would be particularly advantageous to provide an insert than may be mounted to project from a working face to an optimum extent for maintaining a free space beneath the drill member for removal of loose material, for penetrating soft formations, and for reducing wear of the drill member.

## SUMMARY OF THE INVENTION

The present invention provides a new and improved solid wear-resistant sintered metallic carbide insert adapted for forcible insertion into an opening in a working face of a drill member to obviate or minimize the problems previously occasioned by imperfections in such openings and provide a drilling unit having inserts securely mounted in the drill member thereof and resistant to fracture and loss of the inserts, with the inserts also projecting to a desirable extent from the working face of the member.

The new insert of the invention includes a generally polygonal body portion having at least about 12 sides extending between a base end and an opposite head end thereof, and a generally conical wedging portion on the head end of the body portion diverging outwardly therefrom and having an outer diameter greater than the diameter of the body portion, the wedging portion intersecting the body portion whereby the corners formed by the body portion sides terminate intermediate the outer and inner ends of the wedging portion to provide a smooth annular wedging surface on the outer end of the wedging portion, the body and wedging portions being insertable into the working face opening for mounting them therein with the body portion engaging the wall of the opening in an interference fit and the outer end of the wedging portion wedged in the opening adjacent the working face. The wedging portion preferably diverges at an angle of about  $4^{\circ}$ - $6^{\circ}$  from the longitudinal axis of the body portion. The body portion preferably is provided with about 12 to 22 sides in the insert sizes most commonly employed. The preferred metallic carbide comprises tungsten carbide.



The drilling unit of the invention includes a drill member having a working face provided with a generally circular insert opening extending inwardly therefrom, the opening terminating at the working face in an outwardly divergent conical mouth preferably diverging at an angle of about 4°-6° from the longitudinal axis of the opening, and the insert mounted in the opening with the body portion of the insert engaging the wall of the opening in an interference fit, and the outer end of the wedging portion of the insert being wedged in the mouth of the opening. Preferred drill members include rotary-percussion drill bit and roller cutter bodies.

The new insert is constructed for wedged mounting of its conical wedging portion in the mouth of a suitable opening provided in a working face of a drill member, resulting in high compressive forces around the insert in the critical area adjacent the working face. The polygonal body portion of the insert engages the wall of the opening in an interference fit, providing anchoring stability and preventing the insert from turning. The insert and its mounting serve to overcome the common errors in drilling insert openings, without necessity for the usual reaming operation, thereby providing greater resistance to bending and torsional stresses to minimize fracture and loss inserts.

The insert structure and the configuration of the companion opening in the drill member provide for relative ease of insertion of the insert into the opening, without scoring or distorting the mouth of the opening at the working face during insertion. After insertion, the polygonal body portion of the insert is embedded below the working face of the drill member, so as to avoid scoring the working face around the insert.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The attached drawings illustrate preferred embodiments of the invention, without limitation thereto. In the drawings, like elements are identified by like reference symbols in each of the views, and:

FIG. 1 is a fragmentary sectional view of a rotary-percussion drill bit incorporating a drill member and inserts therein according to the invention, with a portion of the drill member broken away to reveal an insert;

FIG. 2 is a fragmentary sectional view of a roller cutter of a drill bit in engagement with a formation being cut, the cutter incorporating a drill member and inserts therein according to the invention;

FIG. 3 is an enlarged elevational view of one embodiment of the insert of the invention, as it appears prior to its finishing operation;

FIG. 4 is a view similar to FIG. 3, illustrating the insert thereof after finishing, and showing the insert as it is being inserted into an insert opening in a drill member, illustrated fragmentarily in section;

FIG. 5 is a view similar to FIG. 4, showing the insert as being completely inserted into the insert opening;

FIG. 6 is a schematic sectional view illustrating comparatively the insert structure of the invention and a prior insert structure, each shown in half section, as mounted in a disc portion of a disc roller cutter, shown fragmentarily in section;

FIGS. 7 and 8 are, respectively, side elevational and top plan views of another embodiment of the insert of the invention; and

FIG. 9 is a side elevational view of a further embodiment of the insert of the invention.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, FIG. 1 illustrates a rotary-percussion drill bit or unit 10 incorporating a bit body or drill member 11 and a plurality of solid wear-resistant sintered metallic carbide inserts 12 mounted therein according to the invention. An optional insert 14 is also illustrated in broken lines. FIG. 2 illustrates a roller cutter 16 incorporating a cutter body or drill member 17 and the inserts 12 mounted therein. The roller cutter 16 is of the type described in U.S. Pat. No. 3,385,385, to which reference may be made for the otherwise

conventional structure of the roller bit embodying the cutter 16.

Referring to FIG. 3, an insert 12' is illustrated substantially as it appears after molding and sintering, and before finishing. When finished, the insert 12' becomes the insert 12 shown most clearly in FIGS. 4 and 5. The insert 12' is a unitary structure of integral portions including a generally polygonal body portion 18, a shallow beveled base or seat portion 20 on the base end of the body portion, a generally conical or frustoconical wedging portion 22 on the head end of the body portion, and a generally hemispherical head portion 24 on the outer end of the wedging portion and conterminous therewith.

The body portion 18 includes a plurality of polygon sides 26 of uniform dimensions, there being 20 sides in the illustrative embodiment. The sides extend substantially parallel to the longitudinal axis 28 of the insert. The sintering operation by which the insert is produced results in a slight concavity, not illustrated, which is greatest in the central region 30 of the body portion and decreases along a curve in the directions of the base portion 20 and the wedging portion 22. As previously described, the concavity results from differences in density owing to the manner in which the insert 12' is molded, i.e., between dies exerting pressure in the direction of the axis 28 at the opposite ends corresponding to the base portion 20 and the head portion 24. The polygon sides 26 thus are approximately flat but slightly bowed inwardly. The sides 26 form corners 32 at their junctions, which are also generally parallel to the longitudinal axis 28 and slightly bowed inwardly.

In a modification of the insert 12', not illustrated, the body portion 18 may be molded with a slight inward tapering in the direction from the wedging portion 22 to the base portion 20. Tapering of the body portion provides for wedging the body portion in an insert opening in a drill member, especially in the case of an unreamed opening suffering from irregularities. However, the remaining insert structure of the present invention makes optional the provision of a tapering body portion.

The base portion 20 includes a beveled peripheral edge 34 and a truncate end surface 36. The peripheral edge 34 lies at a preferred angle of about 20°-25° to a plane perpendicular to the longitudinal axis 28. The base portion is substantially conterminous with the body portion 18. In a modification, not illustrated, the peripheral corner 44' formed at the junction of the peripheral edge 34 and the body portion 18 may be rounded or radiused in molding, for greater ease of insertion in an insert opening.

The conical wedging portion 22 includes a circular outer end 38 having a diameter greater than the diameter of the polygonal body portion 18, and a circular inner end 40 encompassed by and tangent to the polygon sides 26. In this connection, the diameter of the body portion 18 as referred to in the specification and claims is measured between diametrically opposed corners 32. Insert sizes as referred to hereinafter, however, refer to the distance between the centers of diametrically opposed sides 26, i.e., the diameter of a circle inscribed within the polygon and tangent to the sides 26.

A conical side 42 of the wedging portion 22 diverges outwardly from the inner end 40 to the outer end 38. The wedging portion 22 thus intersects the body portion 18, whereby the corners 32 formed by the body portion sides 26 terminate intermediate the outer end 38 and the inner end 40 of the wedging portion to provide a smooth annular wedging surface 42a on the outer end of the wedging portion. The side 42 of the wedging portion preferably is inclined at an angle of about 4°-6° to the longitudinal axis 28, and in the illustrative embodiment, the side lies at a further preferred angle of 5° thereto. It is also preferred that the side 42 intersect the polygon corners 32 approximately one-half of the distance between the outer and inner ends 38 and 40 of the wedging portion.

The head portion 24 is hemispherical and conterminous with the outer end 38 of the wedging portion 22. Such head structure is generally preferred for impacting and cutting purposes in percussion and rotary drill bits. Inserts having other



head configurations may be employed along with the foregoing inserts 12 or may be employed alone or in specific locations, as may be preferred, two of such configurations being exemplified in FIGS. 7-9. It is an advantage of the invention that a full size head portion may be provided, and the head portion need not be blunted or shallow to safeguard the insert, as in the past. It will also be observed that the head portion 24 has a greater diameter than the body portion 18, providing a proportionately larger impact end on an insert of a given size.

Referring to FIGS. 4 and 5, the insert 12 is illustrated as it appears after finishing by tumbling in an abrasive medium. A rounded or radiused peripheral corner 44 is formed at the base of the insert, at the junction of the base portion 20 and the body portion 18. The polygon corners 32, having previously been slightly concave, are abraded or rounded increasingly from about the central region 30 of the body portion 18 to the opposite ends thereof, where relatively long radius abraded or rounded corner end surfaces 46 and 48 are provided adjacent the wedging portion 22 and the base portion 20, respectively. Inasmuch as the base end of the body portion 18 is more exposed, the abraded surfaces 48 thereat ordinarily will be of greater extent than the opposite end surfaces 46. In general, the abraded polygon corners 32 will tend to taper slightly in the direction of the base portion 20.

The insert 12 is illustrated in FIGS. 4 and 5 as being inserted in a generally circular insert opening or hole 50 extending inwardly from a working face 52 of a drill member 54, the opening being defined by a sidewall 56 and a bottom or end wall 58. In the conventional structures, the opening 50 is drilled so as to provide a generally cylindrical sidewall corresponding to the sidewall 56 which, however, suffers from irregularities, frequently widening in a direction from the bottom wall 58 to the working face 52. Consequently, the opening conventionally is reamed after heat treatment to render its configuration more nearly cylindrical.

In the invention, the opening 50 is drilled so as to provide an outwardly divergent conical or frustoconical rim 60 forming the outer end of the sidewall 56, adjacent to the working face 52, so that the insert opening 50 terminates in a corresponding outwardly divergent conical mouth. The opening having the conical mouth may be provided readily in a single operation, employing a drill having an appropriate reaming or cutting edge for forming the rim 60. Inasmuch as the rim 60 is formed when the hole is nearly complete and the drill is well centered, imperfections previously occurring at the working face 52 are corrected, with the formation of a substantially conical rim.

The rim 60 of the sidewall 56, like the conical side 42 of the insert wedging portion 22, preferably diverges at an angle of about 4°-6° from the longitudinal axis 28a of the insert opening 50, which is substantially coincident with the longitudinal axis 28 of the insert. In the illustrative embodiment, the angle of divergency is about 5°. The diameter of the rim 60 at the working face 52 is slightly less than the diameter of the insert wedging portion 22 at its outer end 38, to provide for a wedging fit of the wedging portion in the mouth of the opening.

The specification diameter of the insert opening 50 below the rim 60 is the same as the specification size of the insert body portion 18, as measured between the centers of opposite polygon sides 26, to provide for an interference fit between the body portion and the sidewall 56 of the opening. The body portion corners 32 penetrate the sidewall 56 and become wedged in the wall, providing secure anchoring and resistance to turning. The insert mounting further serves to correct for drilling errors while the steel of the drill member conforms to the configuration of the polygon. Drilling errors may be relatively slight near the bottom of the sidewall 56, where the insert diameter is slightly less as a result of abrasive tumbling. The upper regions of the sidewall 56 are more likely to suffer from imperfection such as widening, out-of-round, and loss of resiliency. In these regions, the diameter of the body portion 18 of the insert will be slightly greater after tumbling.

The insert opening 50 is drilled with a drill bit providing a conical bottom wall 58 inclined at about 20°-25° from a plane perpendicular to the axis 28a, corresponding to the inclination of the beveled edge 34 of the insert 12, for firm seating of the insert on the bottom wall. Also, the drill bit may be provided with rounded corners so as to form a rounded corner 62 around the junction of the bottom wall 58 and the sidewall 56.

The structure is well adapted for mounting the insert 12 in the opening 50 without scoring, distorting or weakening the working face 52 in the critical area around the rim 60, such as might otherwise lead to loss of support for the insert in this area. Thus, the conical rim 60 serves to funnel the base portion 20 of the insert into the opening 50, with the rounded bottom corner 44 and the beveled edge 34 of the base portion 20 cooperating in achieving proper insertion. As seen in FIG. 4, the corners 32 of the body portion 18 commence wedging into the sidewall 56 at about the midpoint of the rim 60, at points spaced below the working face 52, leaving an unaltered smooth annular wedging surface 60a on the outer end of the rim adjacent the working face. As seen in FIG. 5, the outer wedging surface 42a on the insert wedging portion 22 ultimately contacts the rim outer surface 60a and then becomes tightly wedged therein as the outer end 38 of the wedging portion reaches a position substantially flush with the working face 52. The body portion 18 of the insert then engages the sidewall 56 in an interference fit, securely anchoring the body portion and resisting rotation thereof. The insert base portion 20 is seated on the bottom wall 58 of the opening. The wedging portion 22 is wedged in the mouth of the opening under high compressive force, to support the insert securely against bending stresses, while the engagement of the body portion 18 resists bending and torsional stresses.

FIGS. 7-9 illustrate additional embodiments of the insert of the invention having differently constructed head portions, and various other head portions may be provided. A chisel insert 64 is shown in FIGS. 7 and 8, which includes a base portion 66, a polygonal body portion 68, and a conical wedging portion 69 constructed like the respective base portion 20, body portion 18, and wedging portion 22 of the above-described insert 12. The insert 64 includes a chisel-type head portion 70 of generally cylindrical configuration, having outermost planar faces 72 disposed at an inclined angle of about 110° and terminating at an outermost narrow transverse cutting edge 74. The periphery of the base of the head portion 70 is coincident with the periphery of the wedging portion 69. As with the preceding insert 12, the chisel insert 64 is mounted with the outer end of the wedging portion 69 flush with the working face of a drill member, and the head portion 70 projects from the working face and is firmly supported for resisting bending and torsional stresses.

FIG. 9 illustrates an insert 76 having a base portion 78, a polygonal body portion 80, and a conical wedging portion 82 like the inserts of the preceding embodiments. An outwardly convergent frustoconical head portion 84 on the wedging portion 82 has a base periphery coincident with the periphery of the wedging portion. The insert 76 is adapted for providing wear resistance in susceptible areas of drill members, and it is firmly mounted in an opening as with either of the preceding inserts. Similarly, an insert according to the invention may be provided wherein the head portion, such as the portion 84, is omitted, for applications wherein the insert is intended principally to impart wear resistance. While the inserts employed for wear resistance may not be subjected to bending and torsional stresses of the magnitude to which inserts having projecting head portions are subjected, they nevertheless tend to loosening in their openings, as a result of deficiencies in mounting and/or wear around the mounting openings. The new structure protects against loss of inserts.

FIGS. 1 and 2 are illustrative of the manner in which the insert of the invention may be employed to advantage in drill members. The drill bit 10 of FIG. 1 includes a conventional bit body 11, of which only the impact end 88 is illustrated. In the complete structure, a shank is integral with the impact end



and serves for connection with a drilling tool including passage means for supplying water or other fluid to a central longitudinal fluid passageway 90 in the bit body. The impact end 88 includes a slightly tapered frustoconical outer base portion 92 and an inner frustoconical connecting portion 94 joining the base portion to the shank of the bit body. The fluid passageway 90 communicates with branch passageways 96 which discharge flushing fluid from the base portion 92.

Working faces or surfaces are provided by the base portion 92 of the bit body 11, including a transverse end face 98 on the bottom of the bit, a side face 100 extending upwardly and slightly inwardly from the end face, and a corner face 101 at an angle to the end face 98 around the periphery of the base portion, one insert 12a being illustrated as mounted in such corner face. The several faces are provided with insert openings or holes 50 such as illustrated in FIGS. 4 and 5. The inserts 12 are mounted in the openings as shown in such views and described above. The optional insert 14 may constitute the insert 76 illustrated in FIG. 9, mounted in an opening like the openings 50.

Fragmentation of a formation is effected principally at the end face 98 having the inserts 12, and at the corner face 101 having the inserts 12a. The insert 14 serves to maintain the gauge of the bit. Alternatively, inserts providing additional cutting action may be mounted in the side face 100 or other corresponding structure, such as illustrated in my U.S. Pat. No. 3,382,940, wherein the impact end of the bit includes a separable head. The inserts and mounting structure according to the invention serve to reduce the incidence of insert fracture and loss, while fully projecting from the working faces for maintaining clearance between the bit body and the formation and also being advantageous for use in softer formations.

The roller cutter 16 shown in FIG. 2 includes a conventional cutter body 17 provided with a plurality of outwardly extending circumferential disc or web portions 104 and 106, and bearing races 108 and 110. Recesses 112 are provided in the disc portions. Relatively small formation breaking lands 114 are provided on the body 17, between the disc portions 104 and 106. Inserts 12 are mounted in openings 50 in the disc portions 104 and 106, in the manner illustrated in FIGS. 4 and 5.

The cutter 16 is designed for cutting kerfs or grooves 116 and 118 in the face of a formation 120 by means of the inserts 12. The formation breaking lands 114 assist in breaking uncut portions of the formation between the kerfs. Alternate inserts 12 on each of the disc portions 104 and 106 are angled outwardly in opposite directions with respect to each other. The design is intended to protect the disc portions 104 and 106 from wear as much as possible, while penetrating the formation. Accordingly, it is desirable that the inserts 12 project outwardly as far as possible without excessive fracture and loss.

The inserts 12 according to the invention serve to provide the desired outward projection from the disc portions 104 and 106, affording clearance of the disc portions from the formation and also the desired penetration of the formation. The resistance to bending and torsional stresses provided by the inserts and their mounting is especially advantageous in roller cutters, inasmuch as they are subjected to heavy stresses of these types.

FIG. 6 schematically illustrates further advantages of the invention. In this view, a half section of the insert 12 of the invention is comparatively illustrated adjacent to a half section of a conventional insert 122, as they are mounted in the working face 124 of a disc or web portion 126 of a disc-type roller cutter. The view illustrates insert head portions 24 and 128 of equal diameter, whereas the body portions 18 of the insert 12 has a smaller diameter and is employed with a smaller insert opening than the body portion 130 of the insert 122. Consequently, a greater thickness of steel wall 132 remains between the insert opening and the outer surface of the disc portion 126 employing the insert 12 than remains in the wall 134 employing the insert 122. The support thus is greater for

the insert 12 and more protection against wear is afforded, further serving to reduce fracture and loss. Alternatively, the diameter of the head portion 24 of the insert 12 may be greater than that of the head portion 128 of the insert 122 for the same diameter body portion. The larger, more projecting head portion 24 then provides greater impacting and cutting surface, more clearance from the formation, and greater penetration of soft formations.

The inserts 12, and other illustrative inserts, preferably are formed of tungsten carbide, also referred to as cemented tungsten carbide or cobalt sintered tungsten carbide. While such carbide is preferred, other carbide compositions might be employed where desirable, such as tantalum carbide, which however produces a more brittle insert.

Drill member inserts most frequently fall in the range of about three-eighths to five-eighths inch in diameter, with one-half inch and five-eighths inch sizes being most frequently used. The inserts of such sizes as provided according to the invention (the size diameter being measured between the centers of opposite polygon sides 26) preferably have at least about 12 sides up to about 22 sides in the polygonal body portion, such as the body portion 18 of the insert 12. Preferably, 18 to 22 sides are provided in the 1/2-inch to 5/8-inch size inserts, with 20 sides being further preferred. The body portion 18 as molded may have a substantially constant diameter, or it may be tapered slightly in the direction of the base portion 20. Thus, when tapered, the body portion 18 preferably is tapered about one-sixteenth inch per foot of the length for short inserts, e.g., having body portions 18 about three-eighths inch in length, and about one thirty-second inch per foot for longer inserts, e.g., having body portions 18 about three-fourths inch in length.

The depth or thickness of the wedging portion 22, measured along the longitudinal axis 28 between the outer end 38 and the inner end 40 of the wedging portion, preferably is on the order of one-eighth inch for 20 polygon sides 26. The depth of the wedging portion may be varied, depending upon the number of polygon sides 26, so as to provide a suitable smooth wedging surface 42a on the outer end of the wedging portion.

The molded and sintered insert 12' preferably is abraded sufficiently to substantially correct for shrinkage in the central region 30 of the body portion, especially in the zone adjacent to the base portion 20. The insert is tumbled in an abrasive medium to provide the abraded or rounded corner ends 46 and 48, with abrasion occurring to a progressively lesser extent in the direction of the central region 30. The abrading operation preferably is conducted by barrel-tumbling in an abrasive medium, such as aluminum oxide and silicon rock wetted with a basar-water solution, in a conventional manner such as sometimes referred to as "prehoning" when applied to cutting inserts for shop tools.

As noted above, the insert openings 50 in the drill members have about the same diameter below the rim 60 as the specification size of the body portion 18, measured between the centers of opposite sides 26. Relatively wide variation in the size of the insert opening is permissible, and the opening need not be true, so that reaming following heat treatment may be dispensed with. Also as noted above, the diameter of the outer end 38 of the wedging portion 22 is slightly greater than the diameter of the rim 60 of the insert opening 50 at the working face 52, e.g., about 0.004 inch greater for a 5/8-inch diameter insert, to provide for a wedging fit.

The invention thus provides a new and improved insert overcoming prior problems and providing advantages in mounting the insert in a drill member so as to minimize fracture and loss, and a more serviceable drilling unit incorporating the drill member and the insert. While preferred embodiments of the invention have been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein within the spirit and scope of the invention. It is intended that such changes and modifications be included within the scope of the appended claims.

I claim:



1. A solid wear-resistant sintered metallic carbide insert adapted for forcible insertion into an opening in a working face of a drill member which comprises
  - a generally polygonal body portion having at least about 12 sides extending between a base end and an opposite head end thereof, and
  - a generally conical wedging portion on said head end of the body portion diverging outwardly therefrom and having an outer diameter greater than the diameter of the body portion,
  - said wedging portion intersecting said body portion whereby the corners formed by said body portion sides terminate intermediate the outer and inner ends of the wedging portion to provide a smooth annular wedging surface on the outer end of the wedging portion,
  - said body and wedging portions being insertable into said working face opening for mounting them therein with said body portion engaging the wall of said opening in an interference fit and said outer end of the wedging portion wedged in said opening adjacent said working face.
2. An insert as defined in claim 1 wherein said wedging portion diverges at an angle of about 4°-6° from the longitudinal axis of said body portion.
3. An insert as defined in claim 1 wherein said body portion has about 18 to 22 sides.
4. An insert as defined in claim 1 wherein said metallic carbide comprises tungsten carbide.
5. An insert as defined in claim 1 having a head portion on the outer end of said wedging portion.
6. A unit for drilling earth formations comprising
  - a drill member having a working face provided with a generally circular insert opening extending inwardly therefrom, said opening terminating at said working face in an outwardly divergent conical mouth, and
  - an insert as defined in claim 1 mounted in said opening, the body portion of said insert engaging the wall of said opening in an interference fit, and the outer end of the wedging portion of said insert being wedged in the mouth of said opening.
7. A unit as defined in claim 6 wherein said drill member is a rotary-percussion drill bit body.
8. A unit as defined in claim 6 wherein said drill member is a roller cutter body.
9. A unit as defined in claim 6 wherein said insert is constructed of tungsten carbide.
10. A solid wear-resistant sintered metallic carbide insert

- adapted for forcible insertion into an opening in a working face of a drill member which comprises
  - a generally polygonal body portion having about 18 to 22 sides extending between a base end and an opposite head end thereof, and
  - a generally conical wedging portion on said head end of the body portion diverging outwardly therefrom at an angle of about 4°-6° from the longitudinal axis of the body portion and having an outer diameter greater than the diameter of the body portion,
  - said wedging portion intersecting said body portion whereby the corners formed by said body portion sides terminate intermediate the outer and inner ends of the wedging portion to provide a smooth annular wedging surface on the outer end of the wedging portion,
  - said body and wedging portions being insertable into said working face opening for mounting them therein with said body portion engaging the wall of said opening in an interference fit and said outer end of the wedging portion wedged in said opening adjacent said working face.
11. An insert as defined in claim 10 wherein said metallic carbide comprises tungsten carbide.
12. An insert as defined in claim 11 having a generally hemispherical head portion on the outer end of said wedging portion and conterminous therewith.
13. A unit for drilling earth formations comprising
  - a drill member having a working face provided with a generally circular insert opening extending inwardly therefrom, said opening terminating at said working face in a conical mouth diverging outwardly at an angle of about 4°-6° from the longitudinal axis of the opening, and
  - an insert as defined in claim 6 mounted in said opening, the body portion of said insert engaging the wall of said opening in an interference fit, and the outer end of the wedging portion of said insert being wedged in the mouth of said opening.
14. A unit as defined in claim 13 wherein said drill member is a rotary-percussion drill bit body.
15. A unit as defined in claim 13 wherein said drill member is a roller cutter body.
16. A unit as defined in claim 13 wherein said drill member is a disc roller cutter body having said working face on a disc portion thereof.
17. A unit as defined in claim 16 wherein said insert is constructed of tungsten carbide.

50

55

60

65

70

75



UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

Patent No. 3,603,414 Dated September 7, 1971

Inventor(s) FRANK E. STEBLEY

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 10, line 32, change "6" to --10--; and

Column 6, line 43, change "inclined" to --included--.

Signed and sealed this 28th day of March 1972.

(SEAL)  
Attest:

EDWARD M. FLETCHER, JR.  
Attesting Officer

ROBERT GOTTSCHALK  
Commissioner of Patents