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(54) **TORSIONAL PINEAPPLE DISSECTION TIP**

(76) Inventors: **James C. Easley**, St. Charles, MO (US); **Edward J. Timm**, Wildwood, MO (US); **Robert F. Spetzler**, Paradise Valley, AZ (US)

Correspondence Address:
KEVIN L KLUG
ATTORNEY AT LAW
11237 CONCORD VILLAGE AVENUE
ST. LOUIS, MO 63123-2273 (US)

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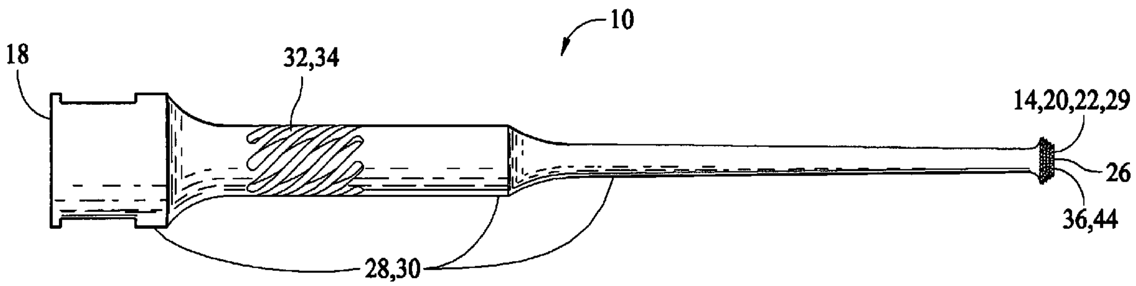
(52) **U.S. Cl.** **606/169**

(57) **ABSTRACT**

A torsional dissection tip and method of use comprising a longitudinal-torsional resonator having a cutting surface at a distal end with cutting teeth of a pitch optimized to the torsional or longitudinal displacement of the distal tip. The present art apparatus and method of use utilizes uniquely designed cutting surface geometries with the aforesaid pitch attributes for surgical applications. Utilization of the present art torsional dissection tip allows a surgeon to easily remove hard tissues such as bone without moving the present art instrument to any site except that which is to be dissected.



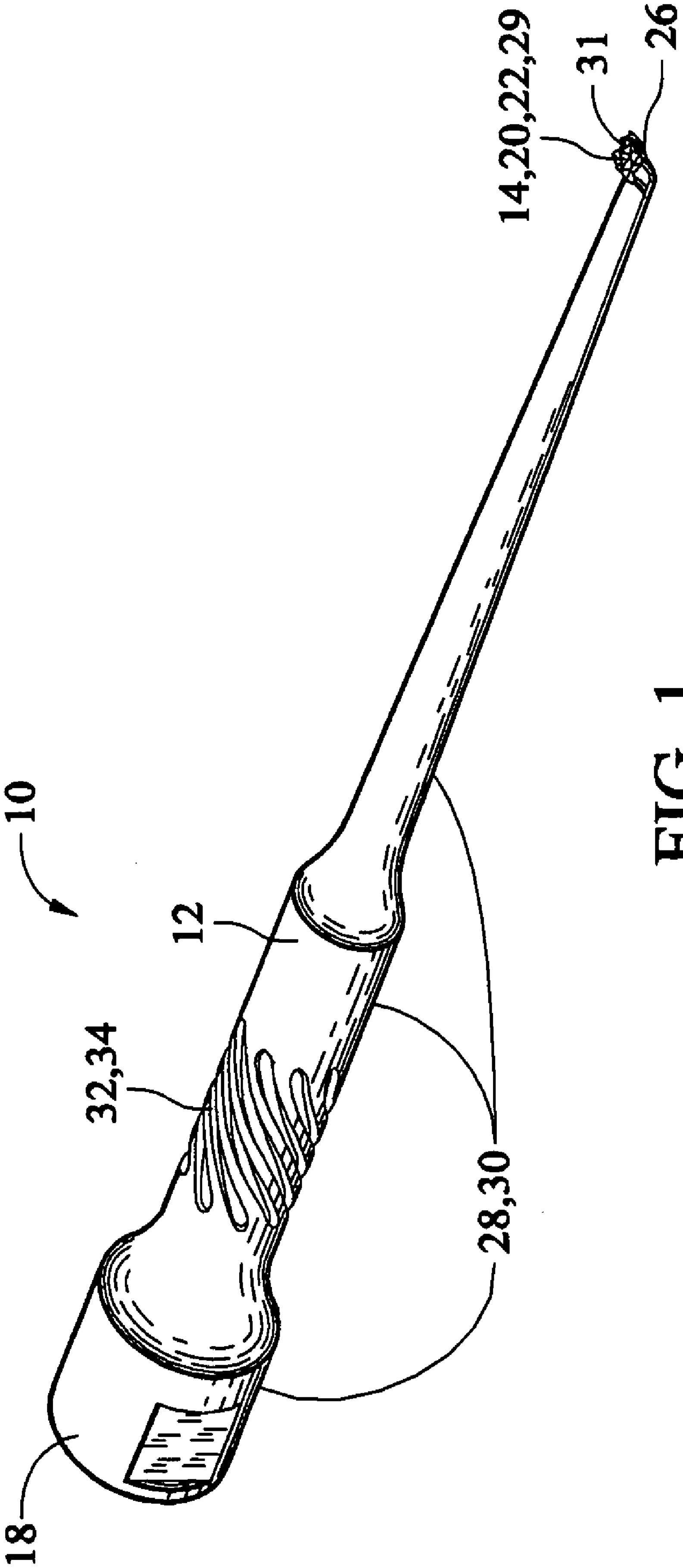


FIG. 1

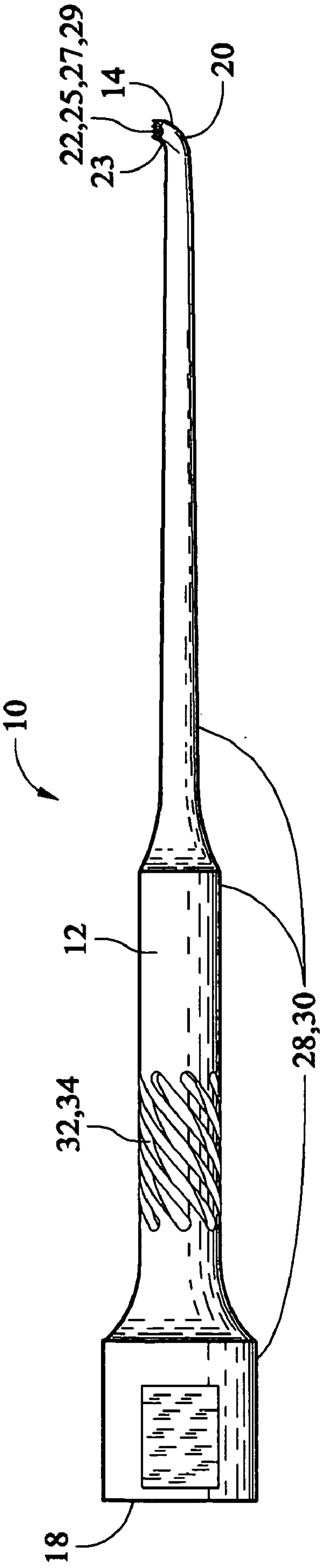


FIG. 2

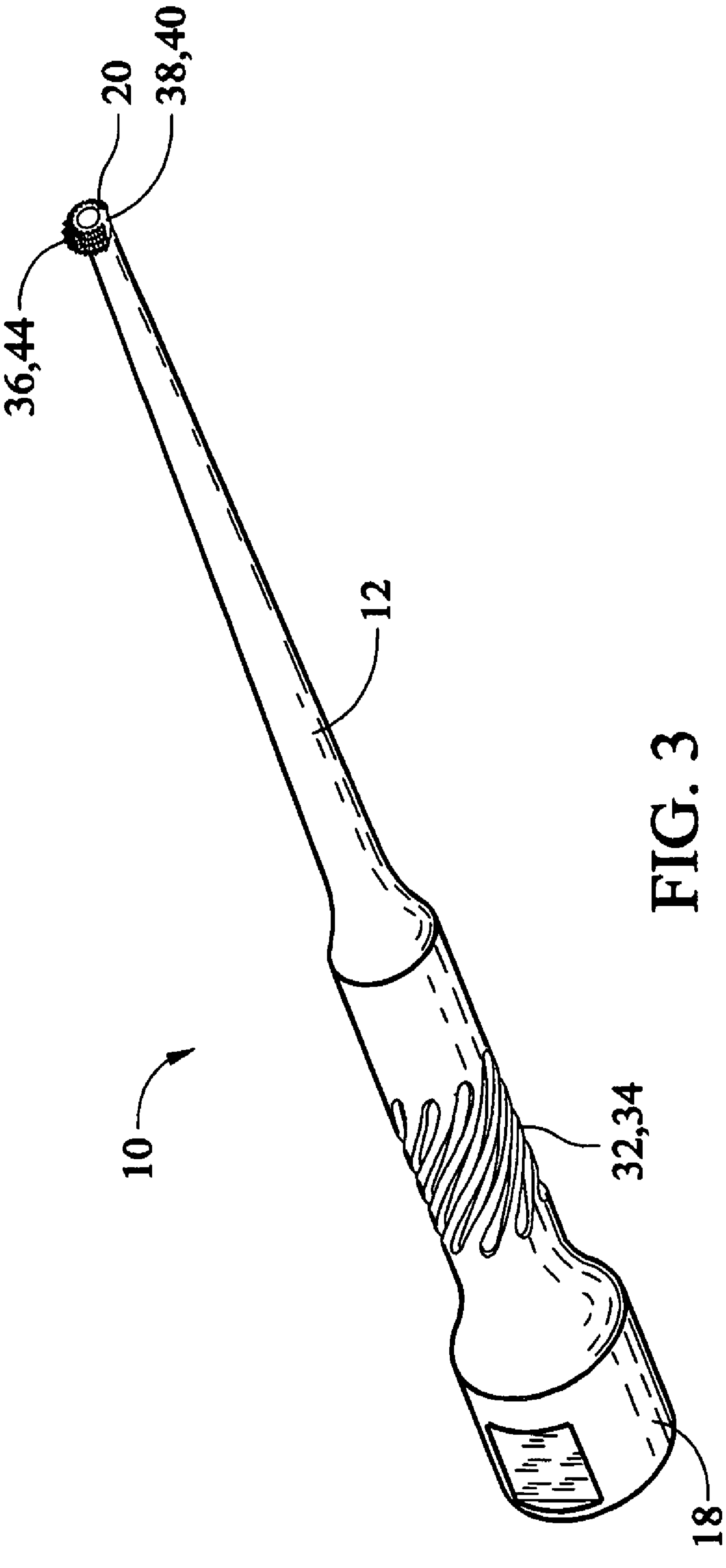


FIG. 3

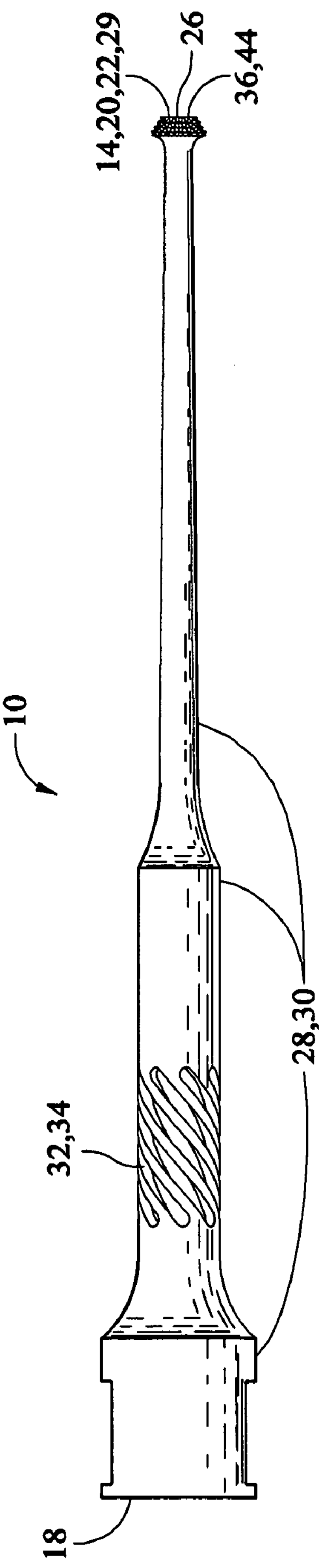


FIG. 4

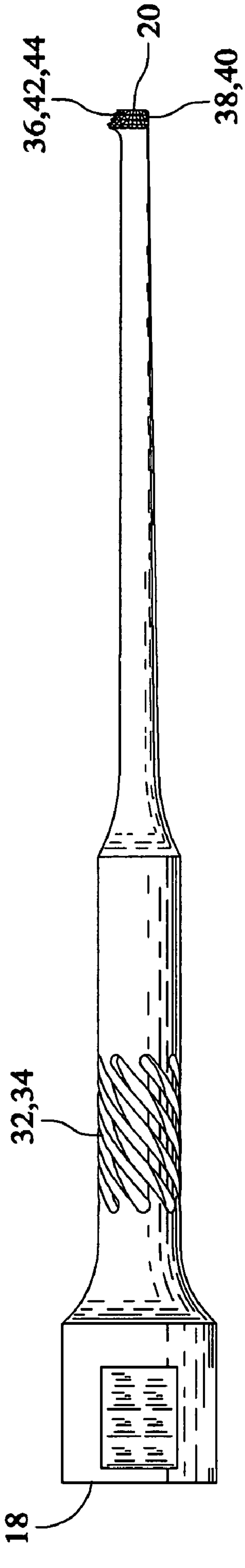


FIG. 5

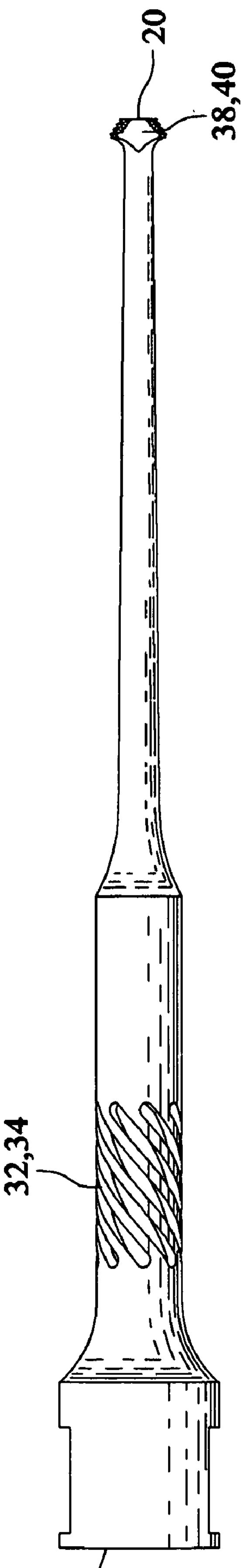


FIG. 6

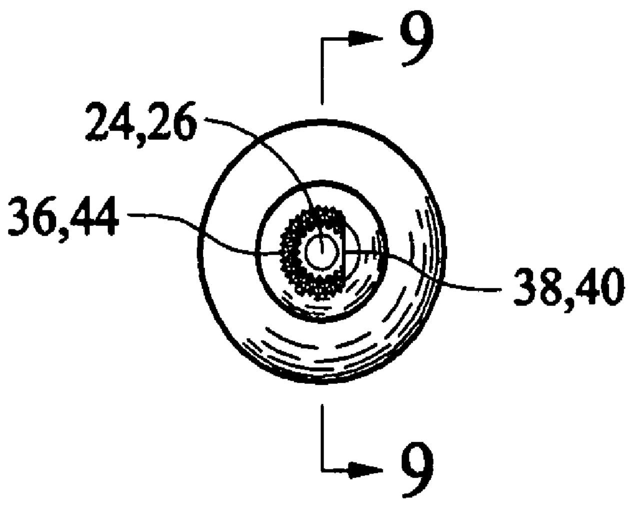


FIG. 7

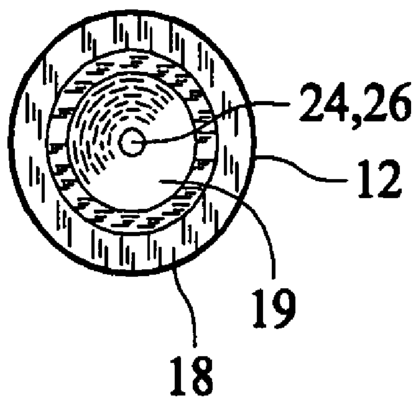


FIG. 8

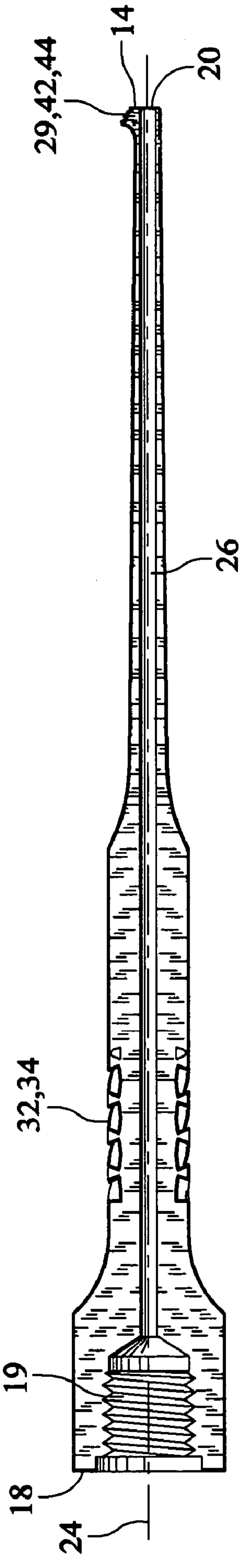


FIG. 9

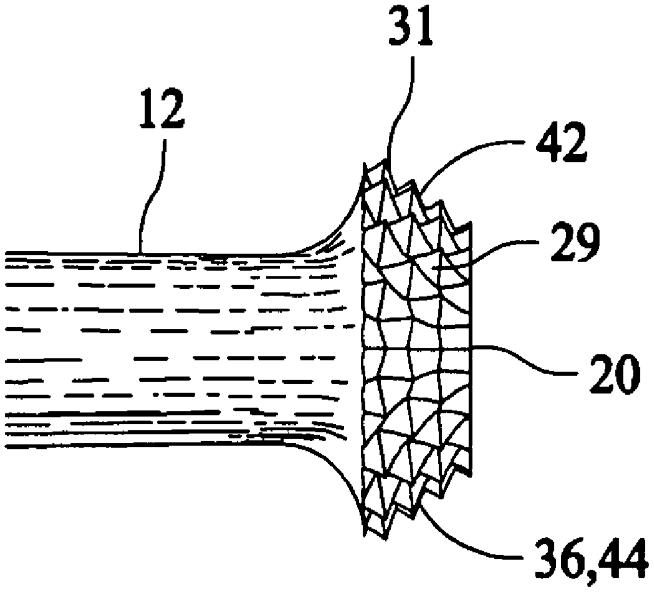


FIG. 10

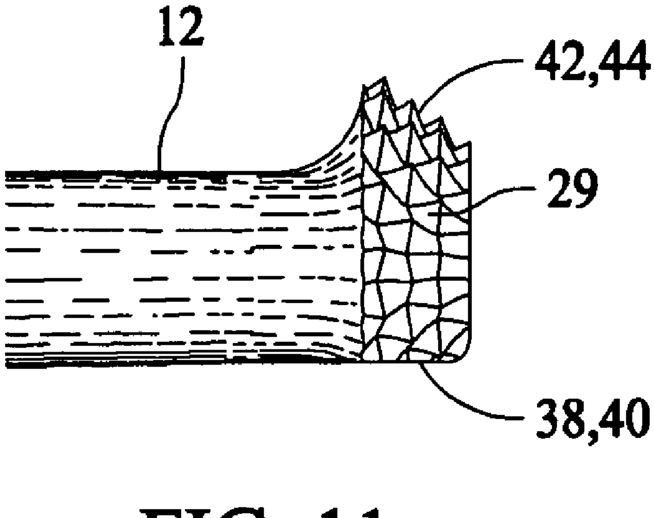


FIG. 11

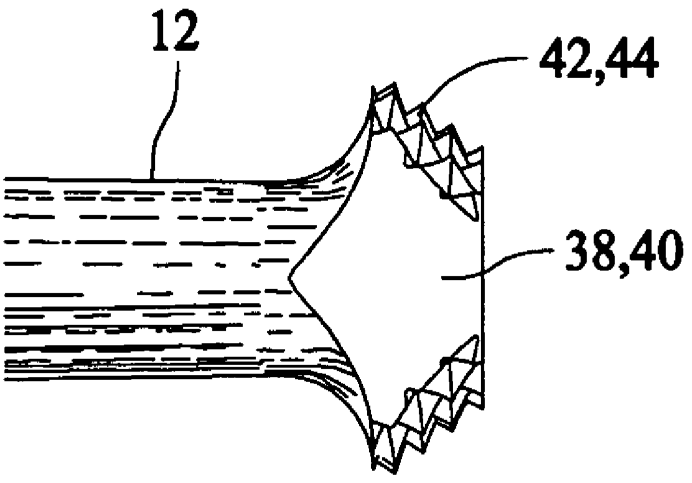


FIG. 12

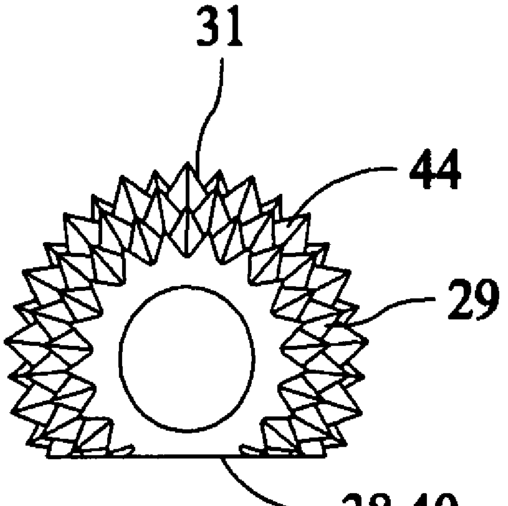


FIG. 13

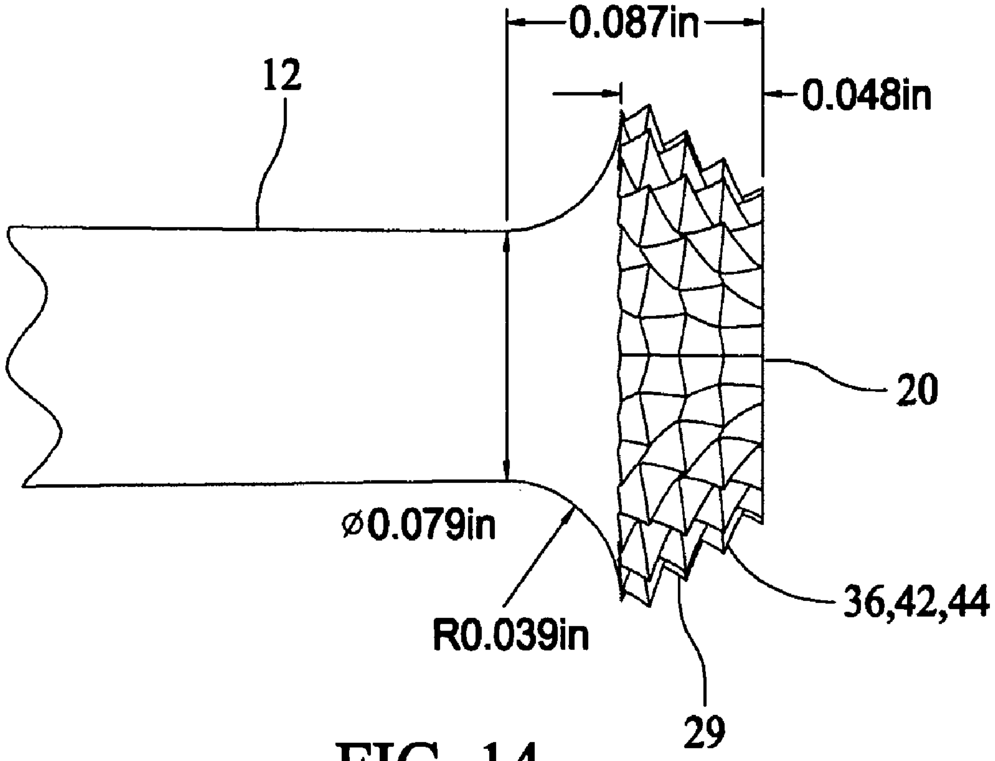

0.087in
0.048in
12
20
⌀0.079in
36,42,44
R0.039in
29

FIG. 14

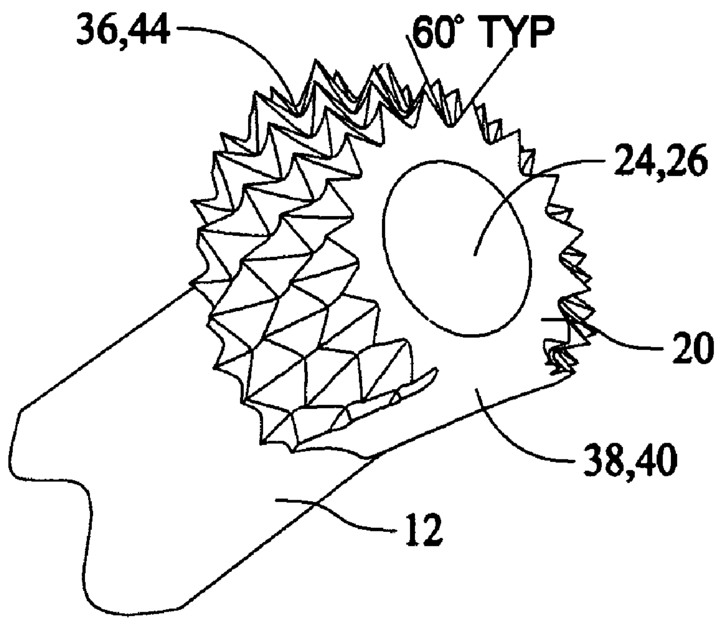

36,44
60° TYP
24,26
20
38,40
12

FIG. 15

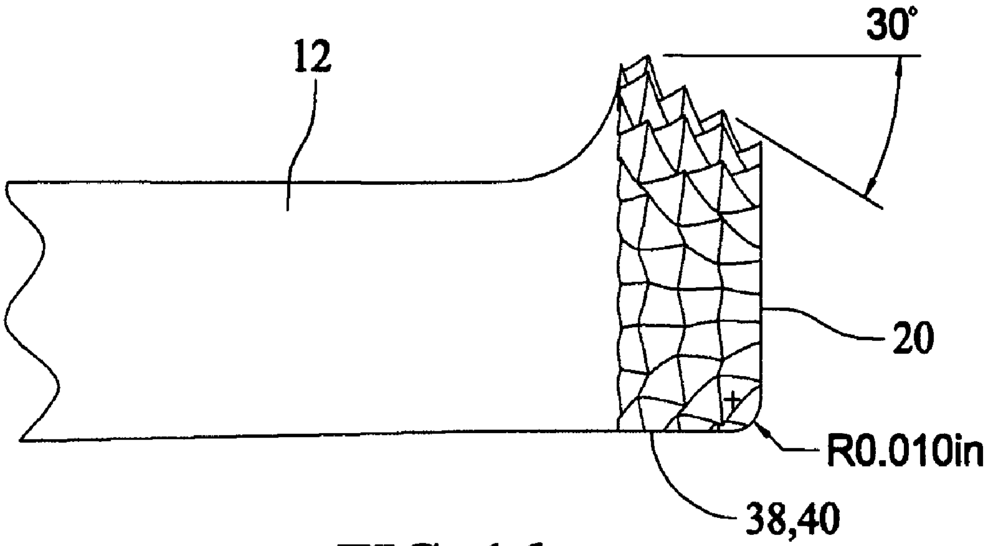

30°
12
20
R0.010in
38,40

FIG. 16

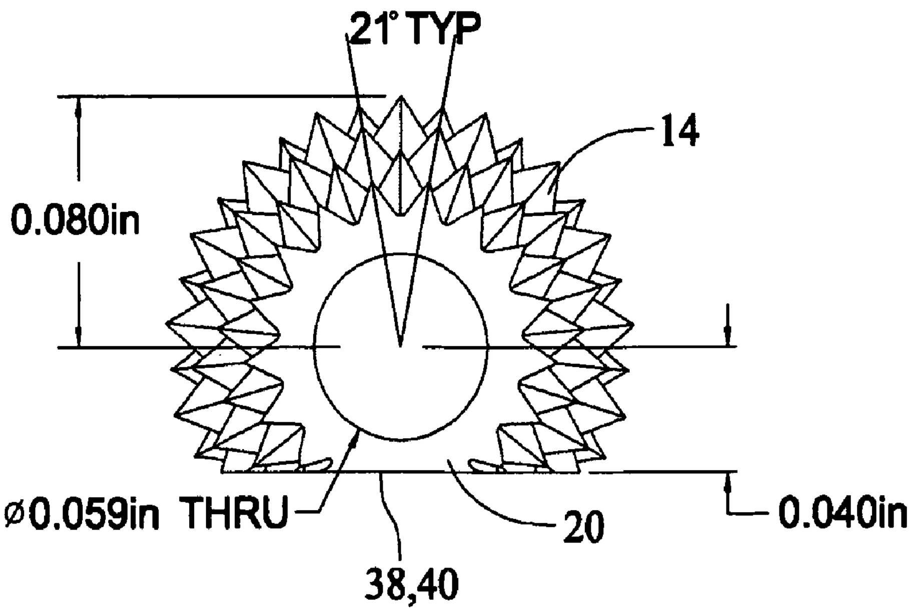

21° TYP
14
0.080in
ø0.059in THRU
20
0.040in
38,40

FIG. 17

TORSIONAL PINEAPPLE DISSECTION TIP

[0001] This application claims priority of U.S. Provisional Patent Application No. 60/584,978, filed Jul. 2, 2004 entitled Torsional Pineapple Dissection Tip.

BACKGROUND OF THE INVENTION

[0002] The art of the present invention relates to torsional dissection tips in general and more particularly to a tip for a linear or longitudinal ultrasonic generator which provides uniquely patterned and formed teeth which are able to uniquely provide torsional and linear dissection of hard or dense biological tissues including intracranial bone. The present art embodiments utilize a unique substantially pineapple shaped head. The art of the present invention is especially suited for dissection of bone and calcified neoplasm during neurosurgery, spinal surgery, orthopedic surgery, plastic/reconstructive surgery, and ear, nose, and throat surgery without the deleterious effects to nearby tissues presented with high speed drilling. The prior art describes a longitudinal-torsional ultrasonic tissue dissection apparatus in U.S. application No. 09/833,109 filed Apr. 11, 2001 by Wuchinich, entitled Longitudinal-Torsional Ultrasonic Tissue Dissection published Nov. 29, 2001 with U.S. publication number 2001/0047166 A1. The aforesaid prior art describes an apparatus for providing torsional movement from a longitudinal ultrasonic generator but fails to provide optimum cutting teeth or head design for hard or dense biological tissues. The prior art utilizes a series of pyramidal shaped teeth spaced apart many times the torsional and/or linear cutting displacement. The aforesaid art is only marginally effective for the intended application. The present art provides a plurality of optimally spaced teeth with a pitch corresponding to a torsional and/or longitudinal stroke of the torsional ultrasonic generator. The present art embodiments provide the aforesaid with an expanded head with pyramidal projections located circumferentially around the distal shaft orifice.

[0003] During many surgical procedures, it is necessary to remove all or a portion of a bony structure in order to provide access to other tissue or organs. In other instances it becomes necessary to shape bone to facilitate approximation of implants, autologous materials, wound closure, etc. Often the shaping or removal of the bony material is done in close proximity to fragile and/or eloquent tissues. In these instances it is desirable that the instrument used for bone removal act in a manner that is predictable and precise. Specific requirements would include, but not be limited to minimization of torque at start up to prevent displacement of the instrument from intended tissue contact, minimized, precise, and discrete tissue impact to restrict alternate site injury potentially caused by the transmitted effect of the instrument, and an overall action that allows the surgeon to focus upon the area of interest rather than having to be concerned with complications secondary to the use of the instrument.

[0004] Much of the current state of the art as it relates to these applications is found in the employment of high-speed air motors or drills. Reaching rotational speeds of up to 95,000 rpm, burrs attached to the air motor affect removal of tissue at varied rates, dependent upon the surface of the burr. Hardened steel cutting tools remove bone rapidly and diamond coated tools affect removal at a much slower rate, but do so with a greater deal of forgiveness, as there is some degree of discrimination in the diamond means of tissue destruction. The spinning burr is directed against the bone to be removed and the cutting surface cuts or grinds it away. A disadvantage of the high-speed burr is a tendency to "skip" from the bone upon initial contact or displacement of the handpiece in the direction of rotation as it contacts the surface to be removed. Due to the constant rotation of the burr, surrounding tissue and/or materials, e.g. sutures, surgical patties, etc., can be inadvertently captured by the rotating shaft of the instrument, thus pulling the tissue and/or materials around the shaft in a "spooling" action. In the case of diamond coated burrs, clearance of chips from the operative site is minimized, thereby trapping the associated heat generated by contact between the tool and the bone. As such, excessive heat generation is a genuine concern, with temperatures in excess of 180 degrees Fahrenheit having been clinically documented. As the generally accepted heat threshold for the inducement of neuronal injury is approximately 109 degrees Fahrenheit, the heat generated by a diamond tool on a high-speed air motor constitutes a genuine clinical concern.

[0005] As aforesaid, recently a means of accomplishing the aforesaid objectives has become commercially available as described in the Wuchinich application. This instrument consists of an ultrasonic motor or generator connected to a shaped tip. The motor is designed to vibrate longitudinally (along its axis), at a fixed frequency with variable amplitude. The tip is designed to convert the longitudinal vibration to a combination of longitudinal and torsional vibration. The aforesaid art teaches how to make an instrument that incorporates longitudinal-torsional motion and how this tip might then be applied to tissue. It does not describe potential tip geometry or configuration that may or may not be advantageous.

[0006] Commercially available embodiments of the aforesaid art utilize a working surface having a plurality of teeth or grooves spaced substantially greater than the torsional and/or linear cutting displacement rather than distinct substantially pyramid shaped teeth which are spaced two times or less than the aforesaid displacement. The present art utilizes a plurality of pyramid or tetrahedral shaped teeth arrayed on the working surface which are spaced in all embodiments at least two times or less than the maximum aforesaid displacement.

[0007] Accordingly, it is an object of the present invention to provide a torsional dissection tip having a plurality of optimally spaced teeth with a pitch corresponding to a torsional and/or longitudinal stroke of the torsional ultrasonic generator.

[0008] Another object of the present invention is to provide a torsional dissection tip having a plurality of optimally spaced teeth, at least two times or less than the longitudinal or torsional tool surface displacement, which may take many different forms, including but not limited to pyramid or tetrahedral shapes, yet function optimally.

SUMMARY OF THE INVENTION

[0009] To accomplish the foregoing and other objects of this invention there is provided a torsional dissection tip for use with an ultrasonic motor. The apparatus is especially suited for use with and during orthopedic surgery. As aforesaid, the present art utilizes a plurality of pyramid, tetrahedral, or other shaped teeth arrayed on the working or cutting surface which are spaced in all embodiments at least two times or less than the maximum aforesaid displacement. (i.e. amplitude)

[0010] For the preferred embodiment, tooth pitch, i.e. distance between successive teeth, is 0.3 or 1 mm, but may comprise any length provided the aforesaid criteria are met. Alternative embodiments of the present art may utilize any type of teeth with a pitch which is substantially optimum for the torsional or longitudinal displacement. For the present and prior art, torsional vibration displacement is typically 300 microns (0.3 mm), with the ratio of longitudinal to torsional displacement regulated by the construction of the tip. While commercially available embodiments of the prior art, such as available from Miwatec of Kawasaki Japan, are capable of accomplishing the clinical objective of bone removal, said prior art requires constant motion of the instrument tip to avoid excessive heat generation, tissue necrosis, and neuronal injury. It is theorized that this excessive heat generation is caused by bone rubbing the sides of the grooves as opposed to the tips of the grooves. That is, the instrument tip typically has both longitudinal and torsional movement and said longitudinal movement is substantially parallel with the prior art grooves. This longitudinal movement when utilized with the prior art does not remove tissue but simply heats said tissue. This excessive heat generation is avoided in the present art via utilization of said plurality of pyramid shaped teeth with the aforesaid optimum spacing.

[0011] The present art invention comprises a longitudinal-torsional resonator (L-T resonator) having a cutting surface tip comprising a plurality of teeth arranged with a pitch, i.e. distance between successive teeth in a plane of motion, substantially equal to the torsional displacement of said tip. Said L-T resonator has a first or proximal end having a preferably female threaded portion which connects with an ultrasonic generator or electromechanical transducer and a second or distal end having said cutting surface plane. A central axis of said L-T resonator is centrally located and extends from said first end to said second end. In a preferred embodiment, a tubular aspiration and/or irrigation path extends from said threaded portion through said second end with an approximate 0.059 inch diameter and forms an orifice at said second or distal end. Alternative embodiments may utilize a plurality of irrigation path diameters. Also in a preferred form, from said first end to said second end said L-T resonator tapers in step form with preferably three steps. Alternative embodiments may utilize any number of steps or simply taper said L-T resonator and further use numerous first end connecting methods recognized within the art including but not limited to screw threads, pins, press fits, welding, brazing or the connection may be metallurgically continuous with the ultrasonic generator. Said ultrasonic generator or electro-mechanical transducer is described in the prior art and is only referenced herein as it interfaces with the present invention.

[0012] As described within the prior art, within the body of said L-T resonator is a cross sectional mass which is inhomogeneous. Said inhomogeneous section may take the form of twisting a flat bar or grooving a round one, i.e. spiraling grooves around the circumference, or varying the density or elasticity of the bar in a helical manner. This inhomogeneity should preferentially be made in the portion of the bar subjected to maximum stress. When the aforesaid inhomogeneity is introduced, longitudinal motion of the ultrasonic generator is at least partially converted into torsional motion at the working surface or distal tip. In the preferred embodiment, said inhomogeneity comprises a plurality of helical grooves within the second step of the L-T resonator.

[0013] In an prior art embodiment, said cutting surface plane is positioned substantially tangential and away from the outside diameter of the L-T resonator at said second end. That is, said surface is preferably positioned on a short arm at said second end away from the outer diameter or circumference of said L-T resonator. Preferably said cutting surface is planar or has a radius which substantially conforms to the radius from the central axis of the L-T resonator to the cutting surface. A preferred embodiment of the present art cutting surface is preferably positioned substantially tangential and parallel in at least a 180 degree arc and away from the outside diameter of the L-T resonator at said second end. That is, said surface is preferably positioned on a short substantially circular arm or projection at said second end away from the outer diameter or circumference of said L-T resonator. Preferably said preferred embodiment cutting surface has a tapered radius or tapered surface relative to the central axis of the L-T resonator whereby said cutting surface forms a partial conical surface with the smallest radius of said conical surface at the second or distal end. As shown in the figures, the present art uniquely incorporates a plurality of cutting teeth on said cutting surface which, unlike the prior art, are capable of cutting hard tissue both longitudinally and torsionally. In the form described, each of said teeth substantially come to a point maximally away from said central axis. In a preferred form, said teeth are pyramidal or tetrahedral in shape and uniformly positioned onto said cutting surface. Said teeth may take substantially one dimensional triangular or rectangular, cubical, or other tetrahedral, pentahedral, or pyramidal forms with any number of surfaces in alternative embodiments without departing from the scope of the present art.

[0014] The present art invention allows the efficient removal of bone with torsional or longitudinal motion of the instrument tip. The device may be applied to ultrasonic motors that vibrate longitudinally, in torsion, or a combination of both longitudinal and torsional motion. That is, unlike grooves of the prior art, the present art plurality of teeth will remove dense tissues when motion is applied in any two dimensional direction along the plane of the plurality of teeth.

[0015] The vibration amplitude or displacement at the working surface is typically approximately 1300 microns (0.3 mm) and the tooth pitch is, in a preferred embodiment, substantially equal to said vibration amplitude. The shape of the teeth and array pattern may take many forms provided the working surface provides a plurality of teeth. For alternative embodiments, the tooth pitch should be no greater than two times the vibration amplitude and as aforesaid, in a preferred form, be equal to or less than the vibration amplitude. This allows the path swept by the vibrating teeth to coincide or overlap with the path of the adjacent tooth. In this manner bone is removed along the entire working surface of the tip, disallowing the entrapment of the heat by the intimate contact of the sides of the teeth with the bone.

As such, heat generation is minimized, bone removal is maximized, and deleterious secondary effects are eliminated.

[0016] The art of the present invention may be manufactured from a plurality of materials having the elastic and hardness properties desired, including but not limited to titanium alloys, commercially pure titanium, and super-elastic alloys such as nitinol. The present art may further utilize anti-reflective surface treatments, coatings, or processes to optimize operation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] Numerous other objects, features and advantages of the invention should now become apparent upon a reading of the following detailed description taken in conjunction with the accompanying drawings, in which:

[0018] **FIG. 1** is a left side perspective view of a prior art embodiment of the torsional dissection tip which is substantially symmetric with a right side perspective view.

[0019] **FIG. 2** is a left side plan view thereof which is substantially symmetric with a right side plan view.

[0020] **FIG. 3** is a left side perspective view of a preferred embodiment of the torsional pineapple dissection tip which is substantially symmetric with a right side perspective view.

[0021] **FIG. 4** is a top side plan view of a preferred embodiment of the torsional dissection tip.

[0022] **FIG. 5** is a right side plan view thereof which is substantially symmetric with a left side plan view.

[0023] **FIG. 6** is a bottom plan view thereof.

[0024] **FIG. 7** is a plan front view thereof.

[0025] **FIG. 8** is a rear plan view thereof.

[0026] **FIG. 9** is a cross sectional view thereof taken along lines **9-9** of **FIG. 7**.

[0027] **FIG. 10** is an exploded top plan view of the distal end of a preferred embodiment tip.

[0028] **FIG. 11** is an exploded right plan view thereof of the distal end of the tip which is symmetric with a left plan view.

[0029] **FIG. 12** is an exploded front plan view thereof of the distal end of the tip.

[0030] **FIG. 13** is an exploded bottom plan view thereof of the distal end of the tip.

[0031] **FIG. 14** another exploded top plan view of the distal end of the preferred embodiment tip with preferred dimensions.

[0032] **FIG. 15** is a exploded perspective view thereof of the distal end of the tip.

[0033] **FIG. 16** is another exploded right side plan view thereof of the distal end of the tip which is symmetric with a left plan view.

[0034] **FIG. 17** another exploded front plan view thereof of the distal end of the tip.

DETAILED DESCRIPTION

[0035] Referring now to the drawings, there is shown in **FIGS. 1-2** a prior art embodiment and in **FIGS. 3-17** a preferred embodiment of a torsional dissection tip **10** having a longitudinal-torsional resonator **12** (L-T resonator) having a cutting surface tip **14** comprising a plurality of teeth **29** arranged with a pitch, i.e. distance between successive teeth **29** in a plane of motion, substantially equal to the torsional displacement of said tip **10**. Said L-T resonator **12** has a first or proximal end having a preferably female threaded portion **19** which connects with an ultrasonic generator or electro-mechanical transducer and a second or distal end **20** having said cutting surface plane **22**. A central axis **24** of said L-T resonator **12** is centrally located and extends from said first end **18** to said second end **20**. In a preferred embodiment, a tubular irrigation path **26** extends from said threaded portion **19** through said second end **20**. Also in a preferred form, from said first end **18** to said second end **20** said L-T resonator **12** tapers **28** in step form **30** with preferably three steps **30**. Alternative embodiments may utilize any number of steps **30** or simply taper said L-T resonator **12** and further use numerous first end **18** connecting methods recognized within the art including but not limited to screw threads, pins, press fits, welding, brazing or the connection may be metallurgically continuous with the ultrasonic generator. Said ultrasonic generator or electro-mechanical transducer is described in the prior art and is only referenced herein as it interfaces with the present invention **10**.

[0036] As described within the prior art, within the body of said L-T resonator **12** is a cross sectional mass which is inhomogeneous **32**. Said inhomogeneous section **32** may take the form of twisting a flat bar or grooving a round one, i.e. spiraling grooves **34** around the circumference, or varying the density or elasticity of the bar in a helical manner. This inhomogeneity **32** should preferentially be made in the portion of the bar subjected to maximum stress. When the aforesaid inhomogeneity **32** is introduced, longitudinal motion of the ultrasonic generator is at least partially converted into torsional motion at the working surface or distal tip **20**. In the preferred embodiment, said inhomogeneity **32** comprises a plurality of helical grooves **34** within the second step **30** of the L-T resonator **12**.

[0037] In a prior art embodiment, said cutting surface **22** plane is preferably positioned substantially tangential and away from the outside diameter of the L-T resonator **12** at said second end **20**. That is, said surface **22** is preferably positioned on a short arm **23** at said second end **20** away from the outer diameter or circumference of said L-T resonator **12**. Preferably said cutting surface **22** is planar **25** or has a radius **27** which substantially conforms to the radius from the central axis **24** of the L-T resonator **12** to the cutting surface **22**. In said prior art embodiment said planar cutting surface **22** has substantially rectangular dimensions of 0.079 by 0.048 inch but may be of any desirable size or area. As shown in the figures, the present art uniquely incorporates a plurality of cutting teeth **29** on said cutting surface **22** which are capable of cutting hard tissue both longitudinally and torsionally. In the form described, each of said teeth **29** substantially come to a point **31** maximally away from said central axis **24**. In a preferred form, said teeth **29** are pyramidal or tetrahedral in shape and uniformly positioned onto said cutting surface **22**. Said teeth **29** may take substantially one dimensional triangular or rectangular, cubical, or other tetrahedral, pentahedral, or pyramidal forms with any number of surfaces in alternative embodiments.

[0038] In a preferred embodiment said cutting surface **22** is substantially partially conical **36** with a portion of the conical surface **36** removed **38** and replaced with a flat surface **40**. Further alternative embodiments may utilize a full conical surface as aforedescribed without utilization of said flat **40**. Said flat **40** surface represents a safe area which will not cut during operation.

[0039] In the preferred embodiment, said cutting surface **22** specifically comprises a partial conical surface **36** initially having a 0.080 inch radius relative to the central axis and tapering **42** at a 30 degree angle to a smaller radius at said distal end. Other radii and angles may be utilized in further alternative embodiments. Said surface **22** preferably consists of an expanded head **44** with pyramidal projections located circumferentially around the distal **20** shaft tubular irrigation path **26** orifice. Preferably the length of said surface as measured along the central axis **24** of the L-T resonator is approximately 0.048 inch with an actual surface length of approximately 0.055 inch but may comprise a plurality of other lengths in alternative embodiments. In the preferred embodiment, said flat **40** replacing a portion of said partially conical surface **36** is positioned 0.040 inch relative to or from said central axis **24** and represents a smooth non-cutting surface along the conical surface **36**. In a preferred embodiment, said flat surface **40** is planarly parallel with said central axis **24**. Also in the preferred embodiment, said surface **36** comprises four adjacent rows of teeth **29** circumferentially arranged around the surface of said partially conical surface **36**, each tooth **29** at a substantially 21 degree angle relative to an adjacent row tooth **29**. The pointed portion or projection of each tooth **29** of each row are preferably positioned adjacent to a trough or indented portion of the successive row teeth. Further alternative embodiments may vary this pattern and number provided the substantially conical form is retained. In the preferred alternative embodiment, the L-T resonator shaft which connects with said cutting surface **36** is approximately 0.079 inch diameter and tapers with an approximate 0.039 inch radius to said initial 0.080 inch radius of the cutting surface **36**. Utilizing the aforesaid geometric form provides at least 260 degrees of cutting surface in a preferred embodiment.

[0040] Further alternative embodiments may vary the aforesaid specific geometric attributes. Specifically, said conical form **36** may be replaced with a radially conical form or pure radial form. Further alternative embodiments may vary the type, pitch, style, and location of teeth. Placement, orientation, and shape of the flat surface **40** may vary or be eliminated in alternative embodiments.

[0041] The present art invention allows the efficient removal of bone with torsional or longitudinal motion of the instrument tip **14**. The device may be applied to ultrasonic motors that vibrate longitudinally, in torsion, or a combination of both longitudinal and torsional motion. That is, unlike grooves of the prior art, the present art plurality of teeth **29** will remove dense tissues when motion **3** is applied in any two dimensional direction along the plane of the plurality of teeth **29**.

[0042] As aforesaid, in the prior art embodiment, the plane of the working surface **22** is substantially parallel yet offset to the central axis of the distal tip **20** of the instrument, however the position of the working surface can be varied in a virtually limitless manner. For the preferred embodiment, the plane of the working surface is substantially partially conical **36** and offset to the central axis **24** of the distal tip **20** of the instrument, and also allows a varied positioning of the working surface in a virtually limitless manner. The plurality of pyramid shaped teeth **29** are arrayed on the working surface **22** with the pointed portions **31** farthest from said central axis.

[0043] The vibration amplitude or displacement at the working surface **22** is typically approximately 300 microns (0.3 mm) and the tooth **29** pitch is in a preferred embodiment substantially equal to said vibration amplitude. The shape of the teeth **29** and array pattern may take many forms provided the working surface provides a plurality of teeth **29**. For alternative embodiments, the tooth **29** pitch should be no greater than two times the vibration amplitude and as aforesaid, in a preferred form, be equal to or less than the vibration amplitude. This allows the path swept by the vibrating teeth **29** to coincide or overlap with the path of the adjacent tooth **29**. In this manner bone is removed along the entire working surface of the tip **14**, disallowing the entrapment of the heat by the intimate contact of the sides of the teeth **29** with the bone. As such, heat generation is minimized, bone removal is maximized, and deleterious secondary effects are eliminated. The term "amplitude" as used herein refers to the peak displacement in a single direction as in the definition of the amplitude of a sinusoid and the term "stroke" refers to the total displacement, i.e. twice the amplitude, as in the peak-to-peak value of a sinusoid.

[0044] During operation, the unique cutting surface or head **22**, **44** allows surgeon orientation of the distal end or tip with a minimal of manipulation. With the preferred embodiment, the surgeon may obtain a 360 degree angle of attack onto the target tissue with less than or equal to a 90 degree hand rotation. This unique minimization of hand manipulation is not found in prior art torsional dissection tips.

[0045] The art of the present invention may be manufactured from a plurality of materials having the elastic and hardness properties desired, including but not limited to titanium alloys, commercially pure titanium, and superelastic alloys such as nitinol. The present art may further utilize anti-reflective surface treatments, coatings, or processes to optimize operation.

[0046] Those skilled in the art will appreciate that a torsional dissection tip **10** has been shown and described. The present invention is contemplated as effective in the removal of bone, bony prominences, calcified neoplasm, cartilage, cartilaginous materials, intervertebral disc, and other pathologies when the cutting surface **22** contacts such. The device is especially useful during neurosurgery, especially inside-out bone dissection once the superficial cortex has been removed, spinal surgery, orthopedic surgery, plastic/reconstructive surgery, and ear, nose, throat surgery, and other surgeries whereby the aforesaid tissues are encountered.

[0047] Having described the invention in detail, those skilled in the art will appreciate that modifications may be made of the invention without departing from its spirit. Therefore, it is not intended that the scope of the invention be limited to the specific embodiments illustrated and described. Rather it is intended that the scope of this invention be determined by the appended claims and their equivalents.

1. A torsional dissection tip comprising:

a longitudinal-torsional resonator having a body, a first proximal end, and a second distal end, said second distal end capable of a torsional motion amplitude and/or a longitudinal motion amplitude when said first proximal end is excited by an ultrasonic generator producing a displacement, and

a substantially conical cutting surface attached with said second distal end; and

a plurality of cutting teeth on said cutting surface; and

said cutting teeth having a pitch less than or equal to two times at least one of said torsional or longitudinal motion amplitudes.

2. The torsional dissection tip as set forth in claim 1 whereby said conical cutting surface further comprises:

a partially conical surface having a removed portion.

3. The torsional dissection tip as set forth in claim 2 whereby said removed portion further comprises:

a substantially flat surface.

4. The torsional dissection tip as set forth in claim 1 further comprising:

a threaded portion at said first proximal end which connects with said ultrasonic generator; and

a tubular path extending from said threaded portion through said second distal end; and

an inhomogeneous cross sectional mass within the body of said longitudinal-torsional resonator, whereby a least a portion of said displacement from said ultrasonic generator is converted to a torsional displacement at said second distal end.

5. The torsional dissection tip as set forth in claim 4, said cutting surface further comprising:

an expanded head having said partially conical surface having a removed portion.

6. The torsional dissection tip as set forth in claim 5 whereby said inhomogeneous cross sectional mass comprises one or more grooves.

7. A torsional dissection tip comprising:

a longitudinal-torsional resonator having a first proximal end and a second distal end, said second distal end capable of a torsional motion amplitude and/or a longitudinal motion amplitude when said first proximal end is excited by an ultrasonic generator, and

a substantially conical cutting surface attached with said second distal end; and

a plurality of cutting teeth on said cutting surface; and

said cutting teeth having a pitch less than or equal to at least one of said torsional or longitudinal motion amplitudes.

8. The torsional dissection tip as set forth in claim 7 whereby said conical surface further comprises:

a partially conical surface having a removed portion.

9. The torsional dissection tip as set forth in claim 8 whereby said removed portion further comprises:

a substantially flat surface.

10. The torsional dissection tip as set forth in claim 9 further comprising:

a threaded portion at said first proximal end which connects with said ultrasonic generator; and

a tubular path extending from said threaded portion through said second distal end; and

an inhomogeneous cross sectional mass within the body of said longitudinal-torsional resonator, whereby a least a portion of said displacement from said ultrasonic generator is converted to a torsional displacement at said second distal end.

11. The torsional dissection tip as set forth in claim 10 further comprising:

an expanded head having said partially conical surface having a removed portion.

12. The torsional dissection tip as set forth in claim 11 whereby said inhomogeneous cross sectional mass comprises one or more grooves.

13. A method of performing dissection of hard or dense biological tissues, the steps comprising:

forming a longitudinal-torsional resonator having a body, a first proximal end, and a second distal end;

ultrasonically exciting and displacing said first proximal end with an ultrasonic generator whereby said second distal end provides a torsional stroke and/or a longitudinal stroke; and

forming and attaching a substantially conical cutting surface with said second distal end; and

forming a plurality of cutting teeth having a pitch less than or equal to at least one of said torsional or a longitudinal strokes on said cutting surface; and

contacting said cutting surface onto a hard or dense biological tissue and thereby removing said tissue without requiring constant motion of said second distal end.

14. The method of performing dissection of hard or dense biological tissues as set forth in claim 13, the steps further comprising:

forming an expanded head on said second distal end; and

shaping said cutting surface on said expanded head into said substantially conical surface.

15. The method of performing dissection of hard or dense biological tissues as set forth in claim 14, the steps further comprising:

removing a portion of said conical surface to form a safe area which will not cut during said removal of said tissue.

16. The method of performing dissection of hard or dense biological tissues as set forth in claim 15, the steps further comprising:

forming one or more grooves within said body whereby said second distal end torsional stroke is maximized.

17. The method of performing dissection of hard or dense biological tissues as set forth in claim 16, the steps further comprising:

forming said cutting teeth from a plurality of pyramidal forms.

* * * * *

patsnap

专利名称(译)	扭转菠萝解剖尖		
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当前申请(专利权)人(译)	EASLEY JAMESÇ TIMM EDWARDĴ SPETZLER ROBERT˚F		
[标]发明人	EASLEY JAMES C TIMM EDWARD J SPETZLER ROBERT F		
发明人	EASLEY, JAMES C. TIMM, EDWARD J. SPETZLER, ROBERT F.		
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摘要(译)

一种扭转解剖尖端和使用方法，包括纵向扭转谐振器，所述纵向扭转谐振器在远端具有切割表面，所述切割表面具有针对所述远侧尖端的扭转或纵向位移优化的节距的切割齿。本发明的装置和使用方法利用独特设计的切割表面几何形状，具有上述用于外科手术应用的间距属性。利用现有技术的扭转夹层尖端允许外科医生容易地移除诸如骨骼的硬组织，而无需将现有技术器械移动到除了要切割的部位之外的任何部位。