(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
23 January 2014 (23.01.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/014653 A1

(51) International Patent Classification:
A61C 3/02 (2006.01)

(21) International Application Number:
PCT/US2013/049024

(22) International Filing Date:
2 July 2013 (02.07.2013)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
13/554,308 20 July 2012 (20.07.2012) US

(72) Inventor; and
(71) Applicant : **SAPIAN, Schubert, L.** [US/US]; 2950 West Camp Wisdom Road, #300, Grand Prairie, TX 75052 (US).

(74) Agent: **FISCHER, Morland, C.**; 2030 Main Street, Suite 1300, Irvine, CA 92614 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) Title: OSCILLATING BLADE FOR CUTTING PERIODONTAL LIGAMENTS AND LUXATING TOOTH ROOTS

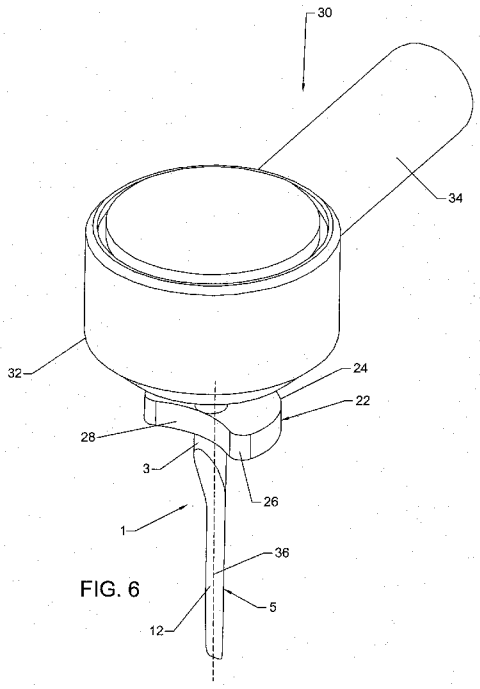


FIG. 6

(57) Abstract: A cutting blade (1, 40, 40-1, 62) having a pair of razor-sharp cutting edges (9, 10) and adapted to be oscillated back and forth in order to cut through the periodontal ligaments which surround a tooth root of a patient during dental surgery so that the root or a portion of a tooth root can be removed from the patient's jawbone. The cutting blade (e.g., 1) has a connecting shaft (3) at one end by which the blade can be coupled to the driver head (32) of an oscillating dental handpiece (30). Located opposite the connecting shaft (3) is a cutting end (5) having a tissue debris transfer canal (12) at the bottom or inside thereof and a smooth tissue gliding surface (16) at the top or outside. A positioning collar (22) surrounds the connecting shaft (3) to provide to the oral surgeon a visual indication of the alignment of the pair of cutting edges (9, 10) of the cutting blade (1) relative to the tissue to be cut.

WO 2014/014653 A1

OSCILLATING BLADE FOR CUTTING PERIODONTAL LIGAMENTS AND LUXATING TOOTH ROOTS

BACKGROUND OF THE INVENTION

[0001] 1. Technical Field

This invention relates to a longitudinally-curved cutting blade adapted to be oscillated back and forth around a tooth root and having a pair of razor-sharp cutting edges that cut through the periodontal ligaments that hold a tooth within the socket of the jawbone. By cutting most of the periodontal ligaments with the disclosed cutting blade, the tooth may be extracted with much less force and with less risk of damage to surrounding bone or other soft tissues.

[0002] 2. Background Art

The need for extracting a tooth arises from a variety of circumstances. Gross decay or trauma may compromise the integrity and function of the crown or the root of a tooth to the point that the tooth must be removed. Wisdom teeth have no functional utility for most patients and can cause a variety of problems that make it advisable to extract them. Such problems can include crowding and distorting the placement of functional teeth causing pain and, because wisdom teeth are hard to reach and clean, increasing the likelihood of oral infection and decay. Traditionally, tooth extraction has been performed using a combination of physical forces that create risk of damaging the bone surrounding the tooth and the adjacent gum tissue. Such techniques include rocking the tooth back and forth using forceps, leveraging the tooth using elevators to create pressure against the surrounding bone or, in some extreme cases, extracting a tooth or root by cutting into the bone or even using a chisel

and hammer. In general, all of these methods pose the risk of damaging the bone socket surrounding the tooth and the gum tissue adjacent to the tooth. This damage increases patient discomfort, requires additional time to heal, and increases the risk of infection. Moreover, in many cases, when the bone surrounding the tooth has been damaged, such damage becomes permanent because of bone resorption. For all of the above reasons, a cutting blade is desirable that will minimize the force required to extract a tooth, minimize damage to surrounding bone and gum tissue, and be compatible with modern dental equipment utilizing high speed power equipment.

SUMMARY OF THE INVENTION

[0003] According to a preferred embodiment, the cutting blade includes a cylindrical connecting shaft at one end and a cutting end at the opposite end. A sloping face extends between the connecting shaft and the cutting end for providing a smooth surface that will slide around the crown of the tooth during surgery. The cutting end has a pair of razor-sharp cutting edges. The connecting shaft is sized and shaped for receipt by the driver head carried by the arm of a conventional oscillating dental handpiece by which the cutting end is oscillated back and forth to cause the cutting edges of the blade to slice through the patient's tissue (e.g., particularly the periodontal ligaments which lie between the patient's jawbone and the root to be extracted). The top of the cutting end of the blade has a smooth curved tissue gliding surface, and the bottom of the cutting blade has a concave tissue debris transfer canal formed therein so that tissue cut by the blade during surgery can be efficiently removed from the cutting site.

[0004] A positioning collar surrounds the connecting shaft of the cutting blade. The positioning collar preferably has a round disk-like top and an arc or similar depression

formed in the bottom and lying opposite the top. The longitudinal axes of the arc of the positioning collar and the cutting end of the cutting blade are co-planar so that the orientation of the arc provides the surgeon with a visual indication of the orientation of the cutting edges of the cutting blade with respect to the tissue to be cut.

[0005] A beveled recess is formed in the tissue gliding surface at the top of the cutting end of the cutting blade. The recess is located between a tissue slicing tip at the front of the cutting blade and a round nose that is spaced rearwardly from the tip. During oscillation of the cutting end, the tissue slicing tip cuts easily through the patient's periodontal ligaments while the round nose located behind the tip slides around and prevents damage to the patient's gum and bone during surgery by limiting the penetration of the tip therewithin.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. 1 is a perspective view showing the bottom and a first side of a double-edged oscillating cutting blade for use during oral surgery according to a preferred embodiment of this invention;

[0007] FIG. 2 is a bottom view of the double-edged cutting blade of FIG. 1;

[0008] FIG. 3 is a perspective view showing the top and the first side of the double-edged cutting blade of FIG. 1;

[0009] FIG. 4 is a side view of the cutting blade of FIG. 1;

[0010] FIG. 5 is an enlarged detail of a tissue slicing tip of the cutting blade taken from FIG. 4;

[0011] FIG. 6 shows the cutting blade of FIG. 1 connected to the driver head of a conventional oscillating dental handpiece so that the cutting blade can be oscillated back and forth for cutting through the patient's tissue;

[0012] FIG. 7 is a perspective view showing the bottom and a first side of a double-edged oscillating cutting blade according to another preferred embodiment of this invention;

[0013] FIG. 8 is a bottom view of the cutting blade of FIG. 7;

[0014] FIG. 9 is a side view of the cutting blade of FIG. 7;

[0015] FIG. 10 is a perspective view showing the top and a first side of the cutting blade of FIG. 7;

[0016] FIG. 11 is a perspective view showing the bottom and a first side of a double-edged oscillating cutting blade according to yet another preferred embodiment of this invention;

[0017] FIG. 12 is a perspective view showing the top and the first side of the cutting blade of FIG. 11;

[0018] FIG. 13 is a perspective view showing the bottom and a first side of a double-edged oscillating cutting blade according to a further preferred embodiment of this invention;

[0019] FIG. 14 is a perspective view showing the top and the first side of the cutting blade of FIG. 13.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0020] The double-edged cutting blade which forms the present invention is disclosed while referring to the drawings. As will be described while referring to FIG. 6, the cutting blade is adapted to be removably coupled to a conventional oscillating driver head of a slow speed oscillating dental hand piece (sometimes known as a right angle hand piece) or of a battery-operated cordless device at which the cutting blade is oscillated so as to be able to cut through the periodontal tissue of a dental patient undergoing oral surgery. It is to be recognized that the cutting blade of this invention can be used on both human and animal patients. As will be described in greater detail hereinafter, the cutting blade has a pair of razor sharp cutting edges. The cutting blade is subjected to an oscillatory or reciprocal (i.e., back and forth) movement during which the pair of cutting edges slice through the patient's tissue, particularly the tissue surrounding a tooth root to be excised. By way of example, the cutting blade of this invention is especially applicable for cutting the periodontal ligaments lying between the patient's jaw bone and the root during oral surgery for the extraction of the root or root tip. By virtue of the reciprocating/oscillating movement of the blade upon the periodontal ligaments and the tooth root, the tooth to be extracted is micro-luxated resulting in a reduction of the extraction force necessary to extract the tooth.

[0021] The details for a double-edge cutting blade 1 according to a first preferred embodiment are disclosed while referring concurrently to FIGs. 1-6 of the drawings. The cutting blade 1 is preferably manufactured from stainless steel or any other suitable flexible

or non-flexible metallic or non-metallic material (including, but not limited to, ceramic, plastic or carbon fiber). The cutting blade 1 includes a cylindrical connecting shaft 3 at the rear end thereof to be coupled to the driver head 32 that is carried by an arm 34 of an oscillating dental handpiece 30 (of FIG. 6). An oscillating driving force generated by the driver head 32 is transferred to the cutting blade 1 at the cylindrical driving shaft 3 thereof for causing the blade to correspondingly oscillate back and forth through an angle of about 30 degrees in order to cut through the patient's periodontal ligamental tissue. For the embodiment shown in FIGs. 1-6, the cylindrical shaft 3 of cutting blade 1 is either solid or hollow.

[0022] Located opposite the connecting shaft 3 at the front of the cutting blade 1 is a cutting end 5. The cutting end 5 is co-extensively joined to the connecting shaft 3 by way of a sloping face 7 that slopes downwardly towards the cutting end. The downwardly-sloping face 7 is preferably beveled to enable the cutting blade 1 to more easily slide around the crown of the tooth during surgery. As is best shown in FIGs. 3 and 4, the cutting end 5 of cutting blade 1 has an arcuate (e.g., curved) configuration. The cutting end 5 and the sloping face 7 of the cutting blade 1 may be formed by machining (e.g., grinding) one end of a solid rod, such the cylindrical connecting shaft 3 lies opposite the cutting end 5 with the sloping face 7 located therebetween. The opposite cutting edges 9 and 10 of the cutting end 5 are thinned and razor sharpened so that the cutting blade 1 is capable of cutting through the patient's periodontal ligaments during each stroke as the blade oscillates back and forth and micro-luxates the tooth root to be extracted.

[0023] The bottom or inside of the cutting end 5 of the cutting blade 1 is machined to have a concave surgical tissue debris transfer canal 12. The tissue debris transfer canal 12 is

preferably a channel that runs longitudinally from the sloping face 7 to a tissue slicing tip 14. Like the sharp cutting edges 9 and 10 of the cutting end 5, the tissue slicing tip 14 is thinned and razor sharpened to enable the cutting end 5 to penetrate and slice through the periodontal ligament tissue to be cut as the blade 1 is oscillated.

[0024] The top or outside of the cutting end 5 at the front of cutting blade 1 has a smooth, curved tissue gliding surface 16 that lies opposite the tissue debris transfer canal 12. The tissue gliding surface 16 has at a round protruding nose 18 (best shown in FIG. 3) that lies behind and is spaced rearwardly from the tissue slicing tip 14. A recess 20 (best sown in FIGs. 3-5) is established in the tissue gliding surface 16 of the cutting end 5 so as to lie between the cutting edges 9 and 10 and extend from the nose 18 to the tissue slicing tip 14. The recess 20 is preferably beveled in the tissue gliding surface 16 by means of a conventional chamfering process. Thus, the thickness of the cutting end 5 of the doubled-edged cutting blade 1 is less at the recess 20 than at the nose 18.

[0025] The curved tissue gliding surface 16 at the top of the cutting end 5 is shaped to advantageously prevent damage to the patient's gingival or soft tissue (i.e., the gums) during surgery. That is, the tissue gliding surface 16 slides smoothly through the patient's tissue once the doubled-edged cutting blade 1 enters the periodontal ligamental (PDL) space. In addition, the curved tissue gliding surface 16 reduces drag which limits damage to and loss of the cortical bone or hard tissue of the patient so as to speed the time for healing following surgery.

[0026] The concave tissue debris transfer canal 12 at the bottom of the cutting end 5 is shaped to create a smooth flow path to permit an efficient removal of the patient's soft and

hard tissues that are cut away during the process of excising of the root as the doubled-edged cutting blade 1 moves through the PDL space. The ability and speed of the blade 1 to slice through the periodontal ligaments is maximized by virtue of the opposite cutting edges 9 and 10 of cutting end 5. Since the PDL space is typically about 0.13 mm to 0.40 mm wide, the cutting end 5 of the double-edged cutting blade 1 must be thinner than 0.40 mm to avoid damaging the patient's jaw bone. The cutting edges 9 and 10 of the cutting end 5 are razor sharp to easily glide into the PDL space as the blade 1 is oscillated by the oscillating driver head 32 of the oscillating dental hand piece 30 of FIG. 6.

[0027] The beveled recess 20 formed in the top of the cutting end 5 of the doubled-edged cutting blade 1 between the tissue slicing tip 14 and the protruding nose 18 at the tissue gliding surface 16 prevents the tip from cutting and damaging the hard and soft tissues which surround the tooth root as the blade 1 cuts through the PDL towards the root. To this end, the cutting blade 1 is oriented by the surgeon such that the tissue gliding surface 16 at the top of cutting end 5 faces the bone and is turned away from the tooth root.

[0028] A positioning collar 22 is slid into engagement with the double-edged cutting blade 1 or machined with the blade as a single piece so as to surround the cylindrical connecting shaft 3. A cylindrical opening (not shown) through the positioning collar 22 is sized to receive the connecting shaft 3 therethrough. The positioning collar 22 has a round disk-like top portion 24 and either an arc 28 (or similar depression or marking) as shown or a flat (not shown) formed in the bottom portion 26 opposite the round top portion 24. The shape of the round top portion 24 and the arc 28 or flat in the bottom portion 26 may change so long as the shape of one is visually distinguishable from the shape of the other.

[0029] In the embodiment shown in FIGs. 1-4, the positioning collar 22 is oriented in surrounding engagement with the cutting blade 1 so that the longitudinal axis of the arc 28 at the bottom portion 26 is co-planar with the longitudinal axis of the concave tissue debris transfer canal 12 which runs along the bottom of the cutting end 5 in the manner illustrated in FIG. 6 with respect to the plane designated by the reference numeral 36. In other words, the shape and alignment of the arc 28 of the positioning collar 22 correspond with the shape and alignment of the concave bottom of the cutting end 5. In this way, the surgeon will be visually alerted, depending upon the orientation of the arc 28 of the positioning collar 22, as to the corresponding orientation of the cutting edges 9 and 10 of the cutting end 5 as well as the tissue transfer canal 12 and the tissue gliding surface 16 which lie one above the other at the bottom and top of end 5. Thus, the double-edged cutting blade 1 can be accurately positioned and manipulated relative to the patient's tissue so as to be moved into the periodontal ligament space while causing minimal tissue and bone damage.

[0030] The details for a double-edged cutting blade 40 according to a second preferred embodiment are disclosed while referring concurrently to FIGs. 7-10 of the drawings. The cutting blade 40 is adapted to be removably coupled to a battery-powered cordless oscillating device (not shown) at which the cutting blade is oscillated back and forth so as to be able to slice the periodontal ligaments which secure the root of a tooth to the jaw bone of a dental patient undergoing oral surgery for the extraction of the root. The cutting blade 40 is especially useful for surgery in the field or outside a traditional dental office when an electrically-driven dental hand piece is not available.

[0031] Located at the rear of the double-edged cutting blade 40 is a hollow semi-cylindrical connecting arm 42 by which the blade 40 is detachably connected to the cordless oscillating

device. The connecting arm 42 is shaped in order to be mated to and held against a complementary coupler (also not shown) of the oscillating device. Located at the front of the cutting blade 40 is an arcuate (i.e., curved) cutting end 44. The cutting end 44 is preferably manufactured from a flexible metallic or non-metallic material. Located between the connecting arm 42 and the cutting end 44 of blade 40 is a hollow tubular intermediate sleeve 46.

[0032] The hollow intermediate sleeve 46 has a sloping face 48 which slopes downwardly towards and extends to the beginning of the cutting end 44. The downwardly-sloping face 48 of sleeve 46 is preferably beveled to enable the cutting blade 40 to more easily slide around the crown of the tooth during surgery. The opposite edges 50 and 52 of the cutting end 44 of the double-edged cutting blade 40 are thinned and razor sharpened so that the cutting blade 40 is capable of cutting through the PDL space during each stroke as the blade oscillates back and forth. The cutting end 44 of the double-edged cutting blade 40 is tapered inwardly from the intermediate sleeve 46 to a tissue slicing tip 54. The tissue slicing tip 54 can be pointed (as shown), round, straight or saw-toothed.

[0033] With respect to the tapered cutting end 44 shown in FIGs. 7-10 that terminates at the pointed tip 54, it may be appreciated that the narrowest location along the cutting end 44 is the tip 54. The pointed tip 54 facilitates a precise placement of the cutting blade 40 during surgery, especially interproximally between the teeth. Such a pointed tip 54 also allows the accurate creation of a purchase point. On the other hand, a rounded tip (not shown) has more surface area which enables a higher cutting speed and efficiency.

[0034] In this same regard, the cutting end 44 is widest and strongest adjacent the hollow intermediate sleeve 46 where most of the cutting takes place through the PDL. The relatively wide portion of the cutting end 44 is also responsible for micro-luxation which vibrates or moves the tooth root and thereby stimulates collagenase formation. Such formation breaks down the collagen fibers of the PDL for causing water to be released from the collagen.

[0035] Like the cutting blade 1 of FIGs. 1-5, the cutting end 44 of the double-edged cutting blade 40 of FIGs. 7-10 has a surgical tissue debris transfer canal 58 formed at the inside or bottom and a smooth tissue gliding surface 60 at the outside or top. The surgical debris transfer canal 58 has a concave configuration that runs longitudinally between the intermediate sleeve 46 and the tissue slicing tip 54 at the front of cutting end 44. The debris transfer canal 58 lies between the opposite cutting edges 50 and 52 of cutting end 44 and is surrounded by an extension 48-1 of the bevel of the sloping face 48 of the intermediate sleeve 46. The surgical debris transfer canal 58 creates a continuous flow path or channel with the hollow tubular intermediate sleeve 46 to permit an efficient removal of the patient's soft and hard tissues that are cut away during the excision of the tooth root.

[0036] The smooth outside tissue gliding surface 60 at the top of the cutting end 44 is curved to advantageously prevent damage to the patient's gingival soft tissue during surgery. The curved tissue gliding surface 60 also enables the cutting blade 40 to slide smoothly through the PDL space with minimal drag, whereby damage to and loss of the hard tissue and cortical bone is minimized.

[0037] For the double-edged cutting blade 40 shown in FIGs. 7-10, the hollow semi-cylindrical connecting arm 42 and the cutting end 44 are axially aligned and located along the

top of cutting blade 40. In FIGs. 11 and 12 of the drawings, a modified double-edged cutting blade 40-1 is shown where the hollow semi-cylindrical connecting arm 42-1 is located along the bottom of blade 40-1, and the cutting end 44 is located oppositely and along the top of blade 40-1. Such a modified cutting blade 40-1 may be required depending upon the manner in which the connecting arm 42-1 is coupled to the cordless oscillating device. Identical reference numerals have been used to designate identical features of the double-edged cutting blades 40 and 40-1 of FIGs. 7-10 and 11-12.

[0038] FIGs. 13 and 14 of the drawings show a doubled-edged cutting blade 62 having some of the same features as the cutting blades 40 and 40-1 of FIGs. 7-12. Like the cutting blades 40 and 40-1, the double-edged cutting blade 62 is adapted to be detachably connected to a battery-powered cordless oscillating device that is capable of applying a reciprocating back and forth movement (perpendicular to the longitudinal axis of the blade) to the blade 62 for cutting through the hard and soft tissues of a patient undergoing oral surgery.

[0039] Unlike the cutting blades 40 and 40-1, the blade 62 of FIGs. 13 and 14 has a solid semi-cylindrical connecting arm 64 at the rear thereof. A solid intermediate joint 66 is coextensively connected between connecting arm 64 and a cutting end 68 at the front of the cutting blade 62. The solid joint 66 has a sloping face 70 which is preferably beveled. The bottom of the cutting end 68 of cutting blade 62 includes a flat inside surface 72, and the top of cutting end 68 includes a smooth, curved outside tissue gliding surface 74. The inside surface 72 at the bottom of cutting end 68 may also be concave to establish a surgical debris transfer canal like those previously described. The cutting end 68 at the front of blade 62 terminates at a sharp pointed tissue-slicing tip 75. The opposite edges 76 and 78 of the cutting end 68 are thinned and razor sharpened so as to cut through the PDL as the cutting

blade 62 is oscillated back and forth. In the case of the cutting blade 62, the connecting arm 64 is located along the bottom of blade 62, and the cutting end 68 is located oppositely and along the top of blade 62. As with the cutting blade 40 shown in FIGs. 7-10, the cutting blade 62 of FIGs. 13 and 14 can be modified such that the connecting arm 64 and the cutting end 68 thereof are axially aligned and located along the top of the blade 62.

CLAIMS

1. The combination comprising:

force-generating means (30) for generating an oscillating driving force; and

a cutting blade (1, 40, 40-1, 62) for cutting through human or animal periodontal ligaments (PDL) around the root of a tooth so that the root can be extracted, said cutting blade including:

a cutting end (5) having first and opposite cutting edges (9, 10) and a longitudinal axis running between said cutting edges,

a connecting end (3) to be attached to said force-generating means (30) so that said cutting end (5) is responsive to the oscillating driving force generated by said force-generating means, whereby said cutting end is moved in opposite directions for cutting through the PDL, and

a cutting end position indicator (22) that is axially aligned with the longitudinal axis of said cutting end (5) so as to provide an indication of the alignment of the first and opposite cutting edges (9, 10) of said cutting end with respect to the PDL to be cut.

2. The combination recited in Claim 1, wherein said cutting end position indicator (22) is located on the connecting end (3) of said cutting blade (1).

3. The combination recited in Claim 2, wherein said cutting end position indicator (22) surrounds at least some of the connecting end (3) of said cutting blade (1).

4. The combination recited in Claim 3, wherein said cutting end position indicator (22) includes a depression (28) having a longitudinal axis (36) that is coplanar with the longitudinal axis of the cutting end (3) of said cutting blade(1).

5. The combination recited in Claim 3, wherein said cutting end position indicator (22) is a disk (24) surrounding the connecting end (3) of said cutting blade (1) and having said depression (28) formed therein.

6. The combination recited in Claim 1, wherein the cutting end (3) of said cutting blade (1) has a tissue debris transfer canal (12) formed therein and along which tissue cut by the first and opposite cutting edges (9, 10) of said cutting end (5) is removed from said cutting end.

7. The combination recited in Claim 6, wherein said tissue debris transfer canal (12) has a concave channel running along the longitudinal axis of the cutting end (5) of said cutting blade (1).

8. The combination recited in Claim 1, wherein said cutting blade (1) also includes a face (7) that slopes towards said cutting end (5) and lies between said cutting end and said connecting end (3) thereof.

9. The combination recited in Claim 1, wherein said cutting blade (1) also includes a tip (14) located at the front thereof and extending between the cutting edges (9, 10) of said cutting end (5) to slice through the PDL being cut, a nose (18) located on said cutting end and spaced behind said tip, and a recess (20) formed in said cutting end and lying between said tip and said nose, such that said cutting end is thinner at said recess (20) than at said nose (18).

10. The combination recited in Claim 9, wherein the nose (18) located on the cutting end (5) of said cutting blade (1) is round.

11. The combination recited in Claim 1, wherein the connecting end (64) of said cutting blade (62) has a flat portion so as to be received by and attached to said force-generating means (30).

12. The combination recited in Claim 1, wherein the connecting end (42) of said cutting blade (40, 40-1) is semi-cylindrical so as to be received by and attached to said force-generating means (30).

13. The combination recited in Claim 1, wherein said cutting blade (40, 40-1) also includes a hollow sleeve (46) located between said connecting end and said cutting end thereof, said hollow sleeve having a face (48) that slopes towards said cutting end (44).

14. A cutting blade (1, 40, 40-1, 62) for use during surgery to cut through human or animal periodontal ligaments (PDL), said cutting blade comprising a cutting end (5) having opposite top and bottom surfaces, at least one cutting edge (e.g., 9), and a tissue debris transfer canal (12) formed in the bottom surface and running along said cutting end so that tissue which is cut by

said cutting edge (9) during the surgery is removed from the cutting end through said tissue debris transfer canal.

15. The cutting blade (1) recited in Claim 14, wherein said cutting end (5) has a longitudinal axis, and said tissue debris transfer canal (12) is a concave channel formed in the bottom surface and running along the longitudinal axis of said cutting end.

16. The cutting blade (1) recited in Claim 14, wherein said cutting end (5) has a tip (14) at one end and a sloping face (7) at the opposite end, said tissue debris transfer canal (12) extending along the bottom surface of said cutting end (5) between said tip (14) and said sloping face (7).

17. The cutting blade (1) recited in Claim 16, further comprising a stop (18) located on the top surface of said cutting end (5) and a recess (20) extending between said tip (14) and said stop (18), such that said cutting end is thinner at said recess than at said stop.

18. The cutting blade (1) recited in Claim 17, wherein said stop is a round nose (18) which points towards the tip (14) of said cutting end (5).

19. The cutting blade (1) recited in Claim 14, further comprising a position indicator (22) aligned with respect to said tissue debris transfer canal (12) formed in the bottom surface of said cutting end to provide an indication of the alignment of said canal (12) relative to the PDL to be cut by said cutting edge (9).

20. The cutting blade (1) recited in Claim 19, wherein said position indicator (22) has a depression (28) being aligned with respect to said tissue debris transfer canal (12) to provide a visual indication of the alignment of said canal relative to the PDL to be cut.

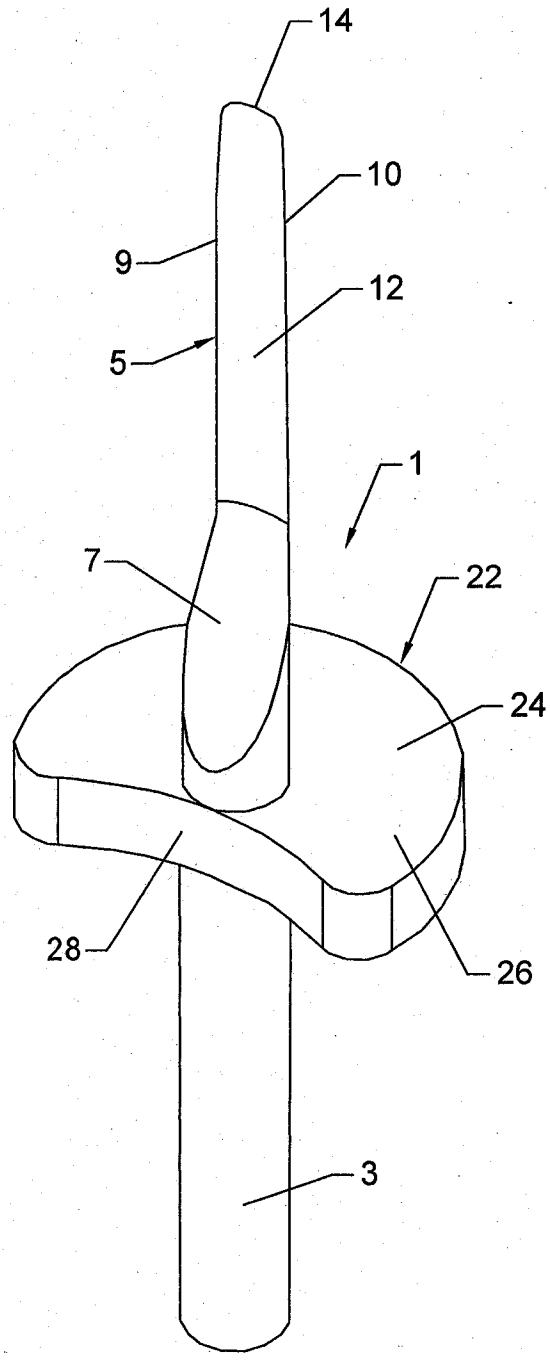


FIG. 1

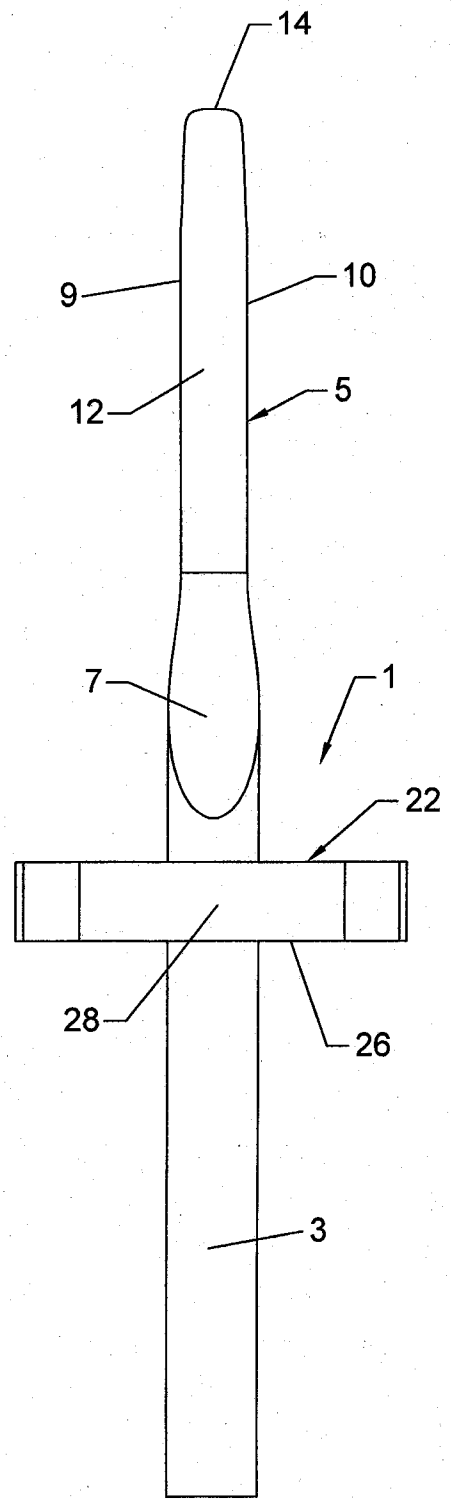
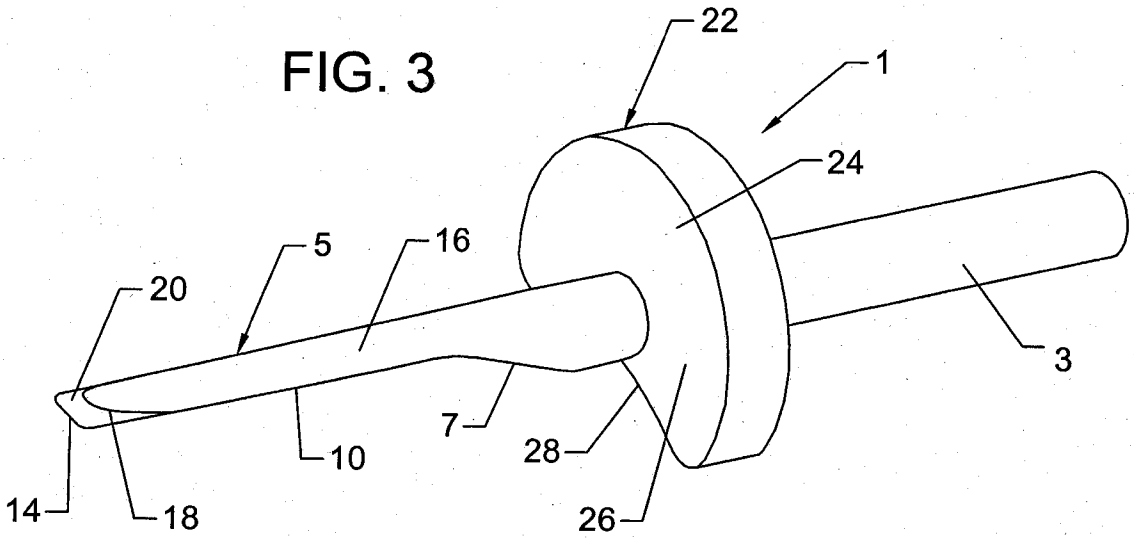


FIG. 2

FIG. 3



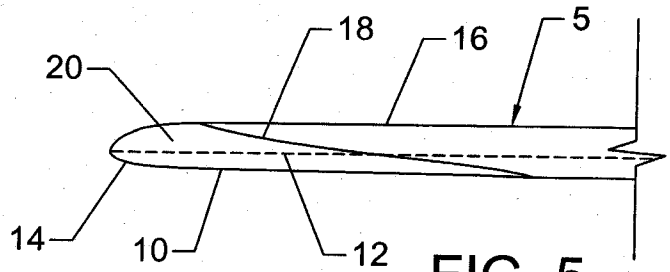


FIG. 5

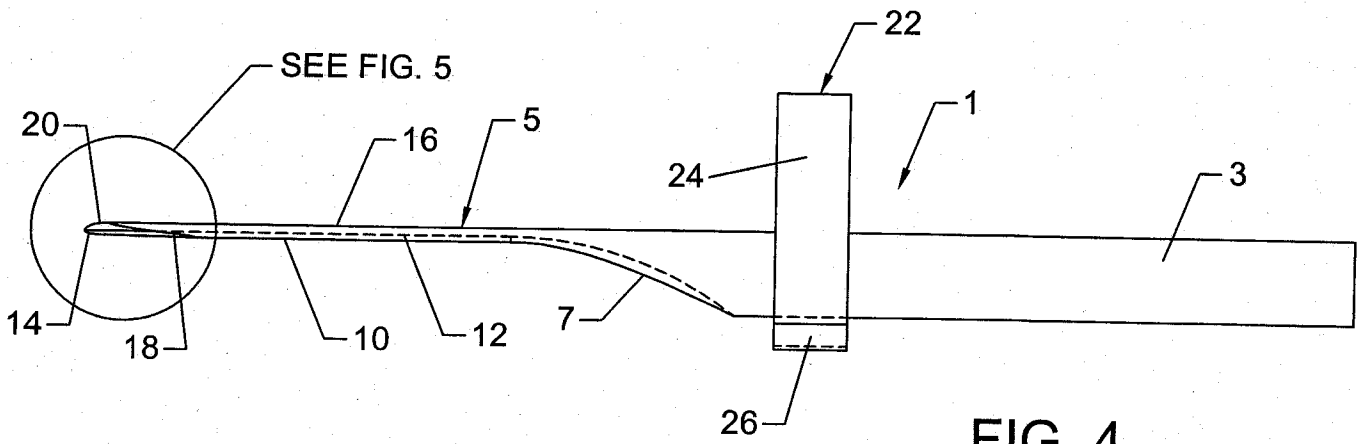


FIG. 4

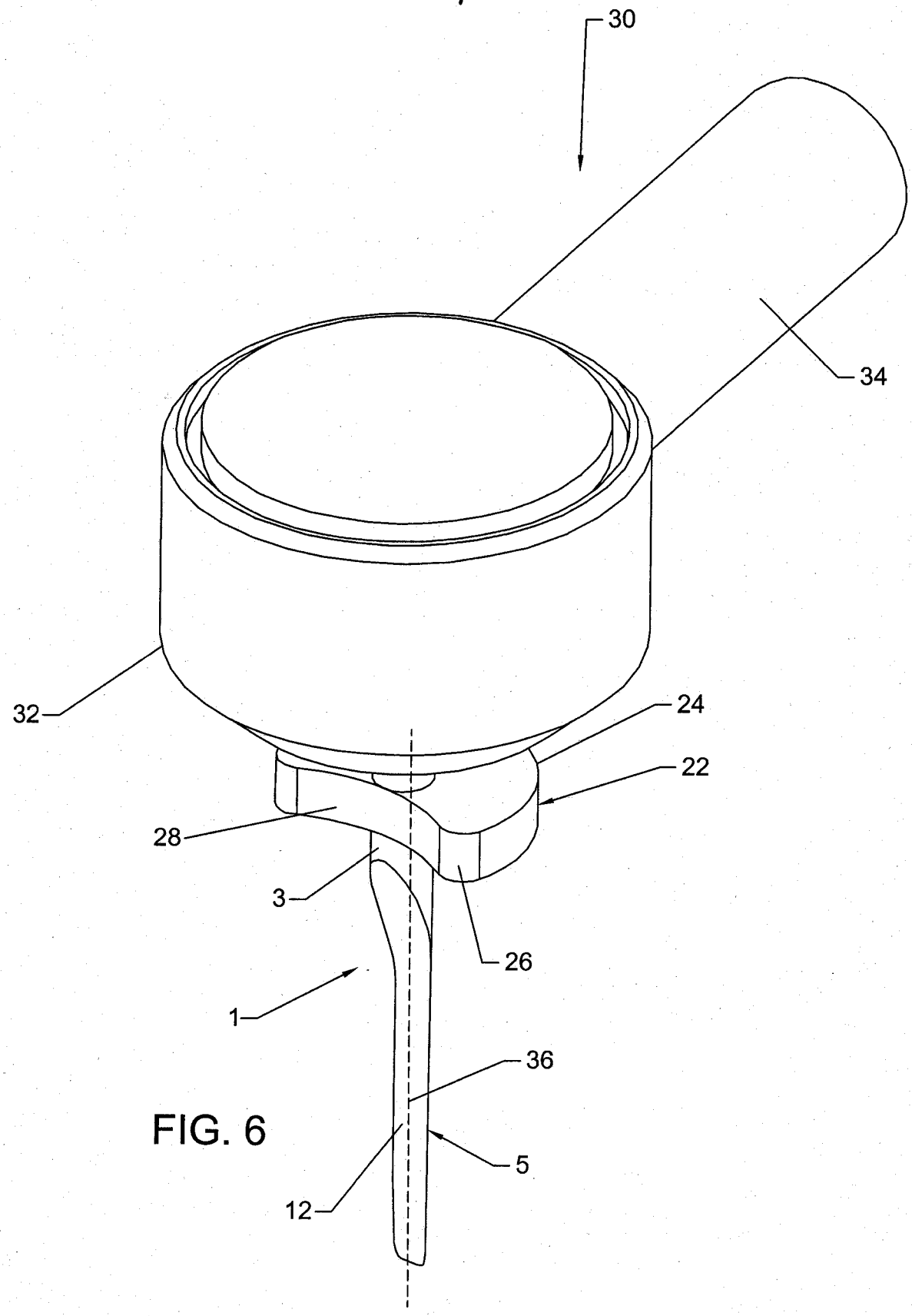


FIG. 6

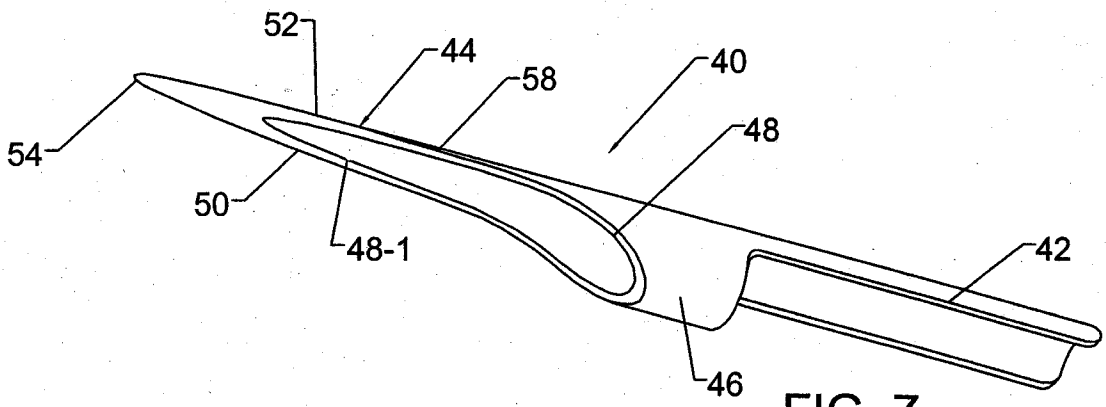


FIG. 7

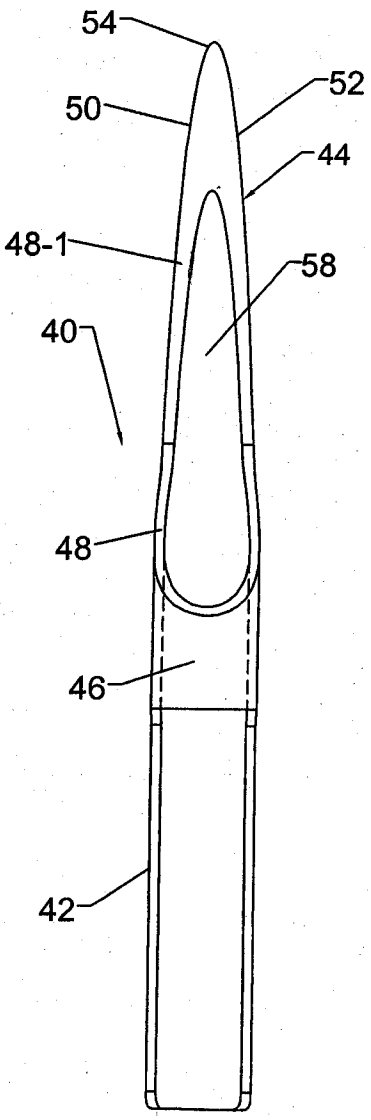


FIG. 8

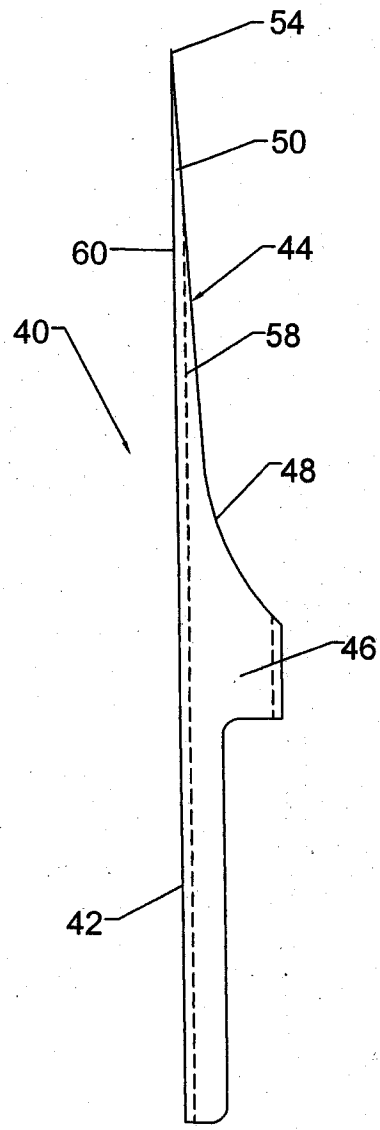


FIG. 9

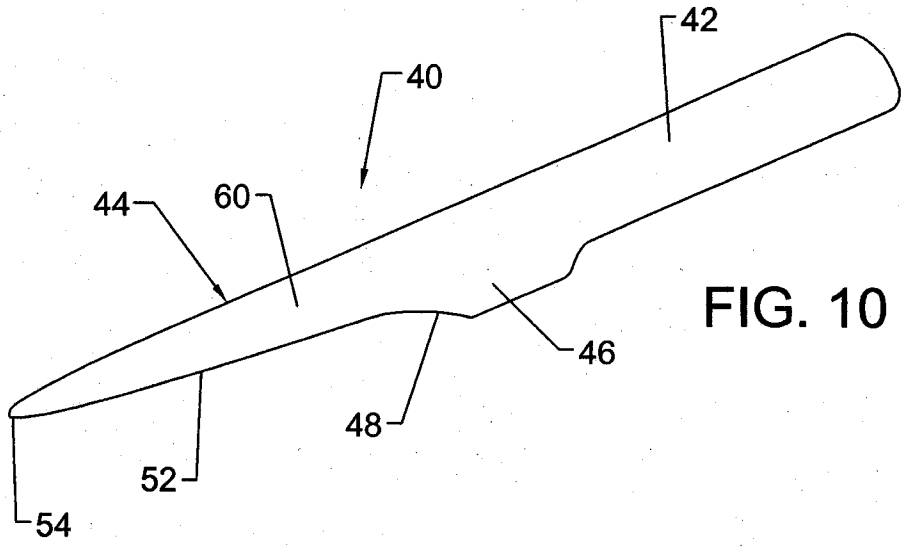


FIG. 10

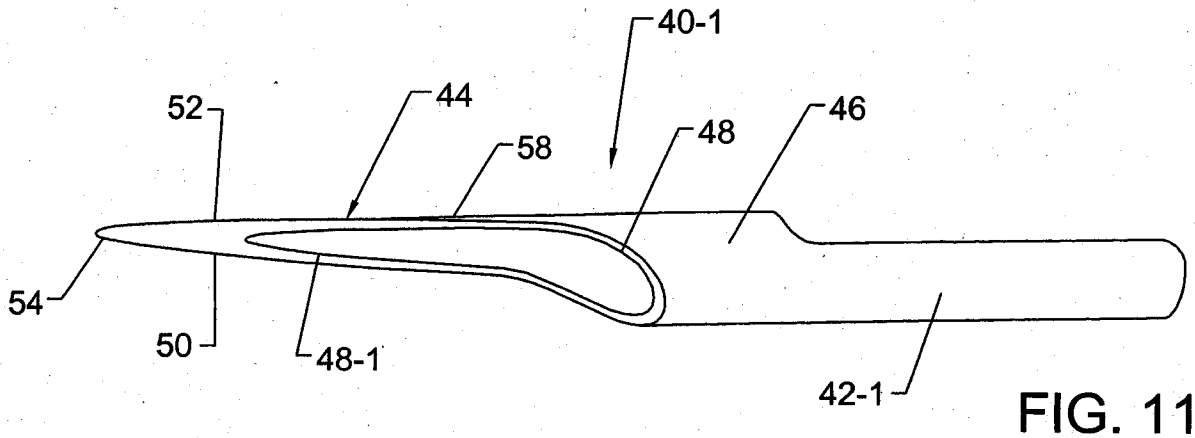


FIG. 11

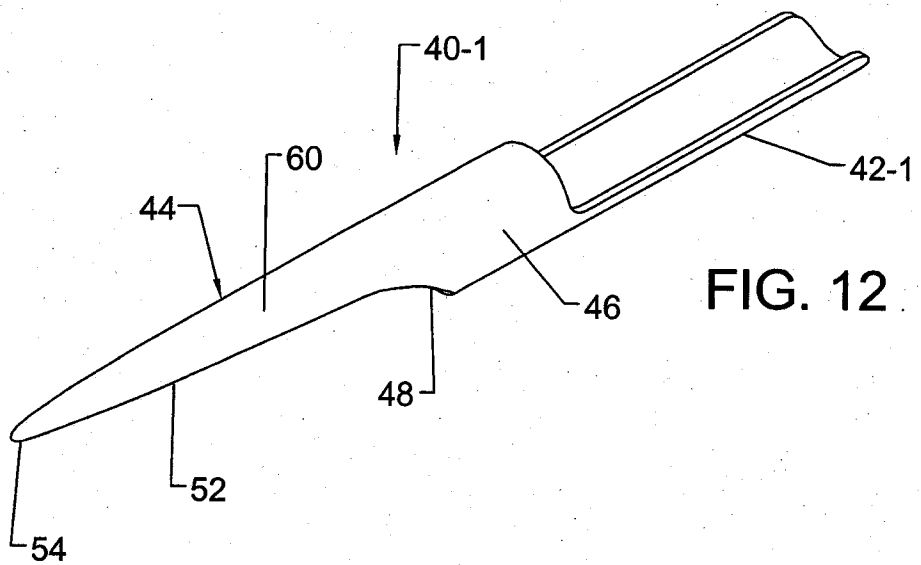


FIG. 12

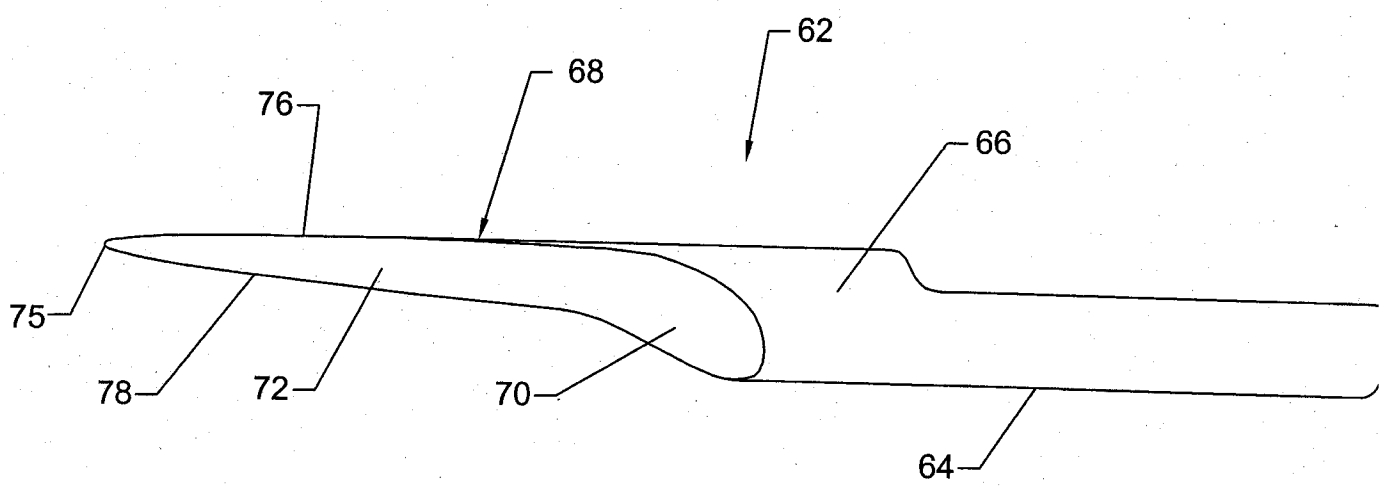


FIG. 13

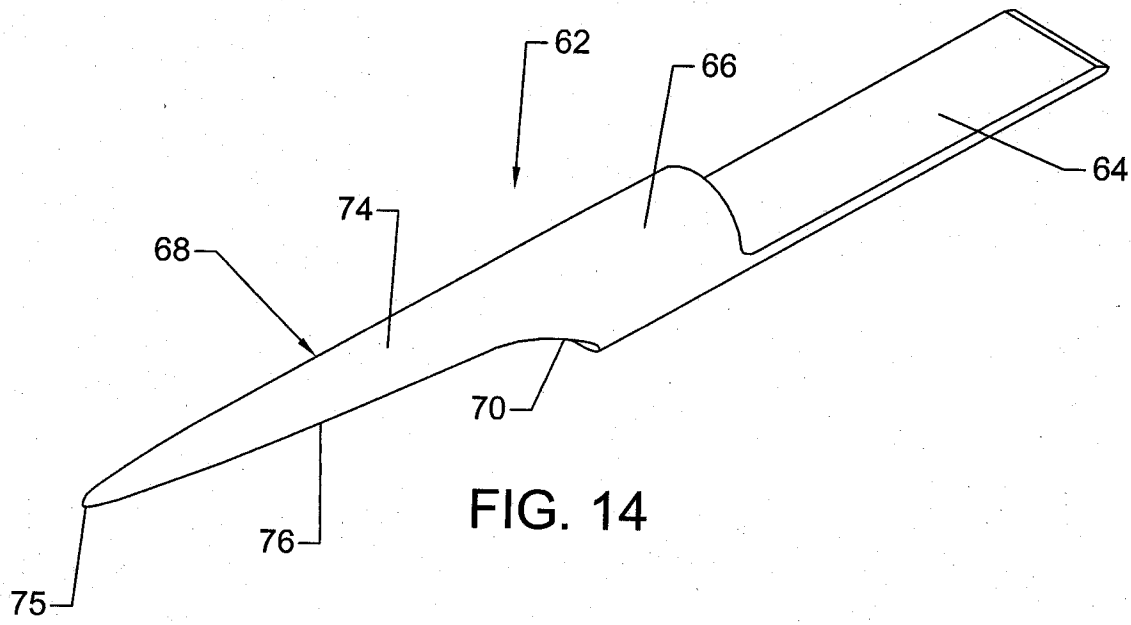


FIG. 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US13/49024

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A61C 3/02 (2013.01)
USPC - 433/144
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8): A61C 3/02 (2013.01)
USPC: 433/144

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
MicroPatent (US-G, US-A, EP-A, EP-B, WO, JP-bib, DE-C,B, DE-A, DE-T, DE-U, GB-A, FR-A); Google; Google Scholar; ProQuest; Medline/PubMed: search terms used; oscillat*, piezo*, power*, motorized, motorised, actuator, vibrat*, blade, cutter, razor, knife-edge, knife, periodontal, periotome, gingival, gums, tooth, root

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6626670 B1 (LERNER, S et al.) September 30, 2003; abstract; figures 4-5; column 2, lines 50-55; column 5, lines 24-25; column 6, lines 1-3; column 7, lines 16-22; claims 1, 4, 11-12, 14, 16, 18	1-13
Y	US 2011/0130779 A1 (MIRZA, A et al.) June 2, 2011; figures 6-7, 18A, 20A, 20B; paragraphs [0011], [0046], [0102]; claim 14.	1-13
Y	US 5007917 A (EVANS, JA) April 16, 1991; abstract; figures 2-3; column 4, lines 9-35; claim 2	6-7
Y	US 4608019 A (KUMABE, J et al.) August 26, 1986; figure 2; column 4, lines 30-35	8
Y	US 6629985 B1 (KIEHNE, VG) October 7, 2003; figure 1	10
Y	US 4733662 A (DESATNICK, AH et al.) March 29, 1988; column 2, lines 33-40; claim 1	11
Y	US 7662109 B2 (HIBNER, JA) February 16, 2010; figure 3; column 6, lines 56-60; column 7, lines 1-2	12
Y	US 6709408 B2 (FISHER, JS) March 23, 2004; figures 1-4; column 3, lines 46-53	13

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"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)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"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
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 November 2013 (21.11.2013)	03 DEC 2013
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US13/49024

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Group I: Claims 1-13 are directed toward a combination comprising: force-generating means for generating an oscillating driving force; a cutting blade; a connecting end to be attached to said force-generating means; and a cutting end position indicator.

Group II: Claims 14-20 are directed toward a cutting blade; with a cutting end; and a tissue debris transfer canal.

-***-Continued Within the Next Supplemental Box-***-

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-13

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

-***-Continued from Box No. III - Observations where unity of invention is lacking -***-

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: the special technical features of Group I include a combination comprising: force-generating means (30) for generating an oscillating driving force; a connecting end (3) to be attached to said force-generating means (30) so that said cutting end (5) is responsive to the oscillating driving force generated by said force-generating means, whereby said cutting end is moved in opposite directions for cutting through the PDL, and a cutting end position indicator (22) that is axially aligned with the longitudinal axis of said cutting end (5) so as to provide an indication of the alignment of the first and opposite cutting edges (9, 10) of said cutting end with respect to the PDL to be cut, which are not present in Group II; the special technical features of Group III include a tissue debris transfer canal (12) formed in the bottom surface and running along said cutting end so that tissue which is cut by said cutting edge (9) during the surgery is removed from the cutting end through said tissue debris transfer canal, which are not present in Group II.

The common technical features of Groups I and II are a cutting blade for use during surgery to cut through human or animal periodontal ligaments; and a cutting end having opposite top and bottom surfaces; and at least one cutting edge.
These common technical features are disclosed by US 2006/0263745 A1 (LASNER). Lasner discloses a cutting blade for use during surgery to cut through human or animal periodontal ligaments (periotome blade 18 and severs periodontal ligaments; figures 4, 5, 6; paragraph [0017]; claim 5); and a cutting end having opposite top and bottom surfaces (blade 18, which contains the cutting end, has opposing top and bottom surfaces; figures 1, 3); and at least one cutting edge (blade has a multiplicity of micro-serrations 20, which serving as cutting edges for the instrument; figures 1, 3; paragraph [0014]).)

Since the common technical features are previously disclosed by the Lasner reference, the common features are not special and so Groups I and II lack unity.