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(54) Title: ELECTRICALLY CONDUCTIVE DENTAL ENDODONTIC POINT

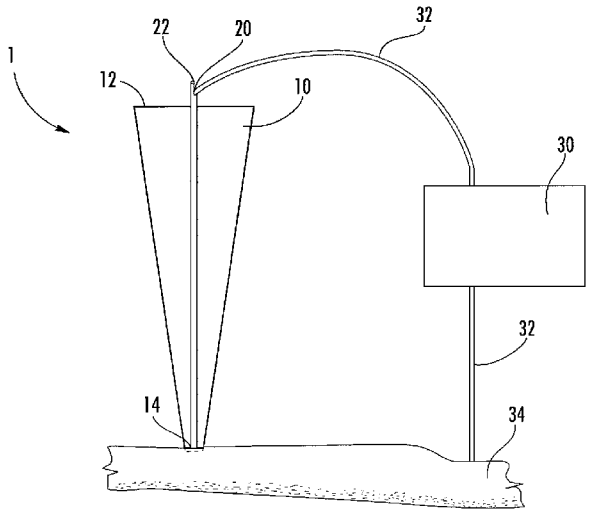

FIG. 2

(57) Abstract: An electrically conductive dental endodontic point device constructed from a hydrophilic polymer housing having an proximal end and a distal end with an elongated electrically conductive shaft placed therebetween. In a preferred embodiment, the electrically conductive shaft is a gold filament or grapheme internally disposed within the length of the endodontic shaft. The improved endodontic point housing has a conical cross-section with the proximal end attached to an apex locator and the distal end constructed and arranged to act as a probe tip to measure the length of a root canal.

ELECTRICALLY CONDUCTIVE DENTAL ENDODONTIC POINT

FIELD OF THE INVENTION

This invention relates generally to the field of dental instruments and in particular to an endodontic point having an internal electrical conductor along its length for use with an apex locator for determining root canal length and position of the apical foramen in endodontic therapy procedures.

BACKGROUND OF THE INVENTION

At the center of every tooth, under the white enamel outer surface, is a hollow area that houses soft tissue such as the nerve, blood vessels, and connective tissue. The hollow area contains a relatively wide space in the coronal (crown) portion of the tooth called the pulp chamber. The dental pulp is the tissue around which the dentin portion of the tooth is composed. Its functions are to form dentin, keep the organic components of the surrounding mineralized tissue supplied with moisture and nutrients making the tooth more resilient, less brittle, and less prone to fracture and act as a sensor subject to extremes in temperature, pressure, or trauma to the dentin essentially providing a security and alarm system for the tooth. Canals in which the pulp is located run through the center of the roots, similar to the way lead runs through a pencil. At the end of each root is an opening in the dentin through which pass the nerves and blood vessels that connect the tooth with the rest of the body's nervous and vascular systems.

A little tooth decay in the tooth structure not extending to dentine may not alarm the pulp. As the dentine becomes exposed, either due to dental caries or trauma, sensitivity starts. The dentinal tubules pass the stimulus to the ondontoblastic layer of the pulp

which in turn triggers response to stimuli, such as in the form of a cold. While simple restoration can be initially performed for treatment, as the tooth decay progresses near the pulp, the response also magnifies the sensation to diet, and hot and cold sensations which can result in moderate to severe sensitivity issues.

Traumatized pulp starts an inflammatory response, and due to the hard and closed surrounding of the pulp, pressure builds inside the pulp chamber compressing the nerve fibers and eliciting extreme pain. In advanced cases the infection of the pulp can migrate into the root(s) of the tooth. At this stage the death of pulp starts which eventually progresses to formation of an abscess within the periodontal tissues surrounding the root. This spread of disease to the outside of the tooth can begin to present long term risk to the health to patient. In such cases a "root canal" is often recommended to address a now most sensitive inflammatory response.

Endodontic therapy or root canal therapy is a sequence of treatments to the pulp of the tooth root which results in the elimination of infection and protection of the decontaminated root from microbial invasion. Endodontic therapy involves the complete removal of everything that lies in the root canal. The hollow area is cleaned, shaped, and decontaminated. Miniscule files and irrigation solutions are used. An inert filling, such as gutta-percha, fills up the hollow, along with a eugenol-based cement. Endodontic therapy is necessary when the pulp, the soft tissue inside the root canal, becomes inflamed or infected. The inflammation or infection can have a variety of causes: deep decay, repeated dental procedures on the tooth, or a crack or

chip on the tooth. An endodontist removes the inflamed or infected pulp, carefully cleans and shapes the inside of the canal, and then fills and seals the space.

The endodontic therapy procedure is comprised of a series of steps: firstly, the endodontist (or dentist) examines and x-rays the tooth, then administers local anesthetic. After the tooth is numb, the endodontist places a small protective sheet called a dental dam over the area to isolate the tooth and keep it clean and free of saliva during the procedure. Secondly, the endodontist makes an opening in the crown of the tooth. Very small instruments are used to clean the pulp from the chamber and root canals and to shape the space for filling. Then, after the space is cleaned and shaped, the endodontist fills the root canals with a biocompatible material, usually a rubber-like material called gutta-percha. The gutta-percha is placed with an adhesive cement to ensure complete sealing of the root canals. During the filling and sealing process, the gutta-percha or similar material is packed in tightly within the root canal in order to fill the canal space completely and thereby prevent bacteria from re-entering and re-colonizing the root interior. Lastly, a temporary filling is placed to close the opening. The temporary filling is later removed and a crown placed on the tooth to protect and restore it to full function.

During the endodontic therapy procedure, it is necessary to measure a working length from the top of the tooth to the apical foramen, the tip of the root stem. Measurement of the working length in the decayed tooth is essential for limiting the access area from endodontic instruments, medicines, and plugging materials so as to prevent the apical tissue from damage during both access cavity preparation and the root canal plugging process.

Conventional techniques, for measuring the working length involves using a file, with a silicone rubber stopper, which is inserted into the access cavity until the apex of the file reaches a position around the apical foramen without piercing the apical tissue or giving pain to the tissue. When the position is reached the rubber stopper is adjusted along the file until the stopper is aligned with the top of the tooth. The file is removed and the length from the apex to the stopper is measured, using an endodontic ruler, to determine the working length. Thereafter, gutta-percha points are measured using the endodontic ruler to equal the corresponding working length. In the case where multiple gutta-percha cones are used in succession, the calibrating instrument provides a guide. The root canal plugging process is then commenced by applying the gutta-percha within until it is aligned with the top of the tooth.

During the root canal plugging process, it is deemed extremely important that the whole length of the root canal be sealed. Should there be dead space between the apical foramen and the apex of the gutta-percha point bacteria may propagate thereinbetween requiring root canal re-treatment. Should the sharpened apex of the gutta-percha exceed the apical foramen and pierce the apical tissue, the apex of the point pressurizes the apical tissue and gives the patient pain. It is important during the plugging process to avoid pushing the filling material so much that it exits the very top of the root where there is a hole that was formerly occupied by blood vessels and nerves that passed through this hole in order to serve the interior of the tooth. With all such tissues removed, there is a risk that the filling material will exit this hole when pressed by an instrument during the compaction process. The instrument

must be a very narrow type of plunger in order to fit down the narrow canal and apply pressure to the pieces of filling material as they are successively place into the canal to be progressively added to the column of material that will be entirely filled by pressing and joining the bits of material until the top orifice of the canal is reached. The risk of pushing the sealing material too far down and out the open end of the canal can be mitigated by measuring the length of the root and setting the compacting instrument to penetrate no further than the root length.

Therefore devices are used in the art to help facilitate the endodontist in determining the apex of the root canal. For example, U.S. Patent No. 7,097,454 discloses a gutta-percha point which is inserted into an access cavity of a decayed tooth to a desired depth, in order to prevent forming dead space in the root canal or piercing the apical tissue. The gutta-percha point has a plurality of engraved or embossed working length marks on its upper portion. This enables an endodontist to be free from having to repeatedly mark working lengths on such points during an endodontic therapy. Other endodontic apex locators are fitted with a collar and thereby set a limit on how far down the instrument is pushed into the canal. When the collar makes contact with the top of the tooth, the endodontist extends the instrument no further. While this precaution will ensure that the tip of the instrument will stay within the confines of the canal, it cannot guarantee that the material being pushed ahead of the instrument tip will stay within the canal. There also remains some risk that material will be pushed out the end of the canal (a condition known as overextension) into the surrounding

periodontal tissues, causing irritation, prolonged discomfort, and perhaps more serious medical complications.

Electrical dental diagnostic devices for locating the apex and measuring the working length within the root canal are also known. An electronic apex locator is an electronic device used in endodontics to determine the position of the apical foramen and thus determine the length of the root canal space. The apex of the root canal has a specific resistance to electrical current, and this uses a pair of electrodes typically hooked into the lip and attached to an endodontic file. For example, U.S. Patent No. 3,916,529 discloses a method and device for determining the length of a root canal using a thin flexible metal wire, electrically coupled to a power source and current meter. The wire is introduced into the root canal and advanced until the probe's tip reaches the root apex. The electronic apex locator passes a current through the wire and a grounding electrode, usually attached to the patient, and measures electrical resistance to determine the length of the root canal.

The drawback associated with the electrical apex locator devices that utilize instruments such as a thin wire, an endodontic file, or a metal tool as a conductive probe is that they are susceptible to electrical interference. Should the thin wire, endodontic file, or metal tool make contact with conductive bodies, such as silver amalgam fillings, porcelain fused to metal crowns, or large lateral canals, other than the periapical tissue surrounding the root apex, then erratic readings on the apex locator will be registered.

Thus what is lacking in the art is an improved endodontic point having an internal electrical conductor along its length to measure the length of a root canal

that minimizes or eliminates electrical interference, thus avoiding the risk of over or under filling a canal during the endodontic treatment.

SUMMARY OF THE INVENTION

An electrically conductive dental endodontic point device for use in endodontic therapy constructed from a housing having a proximal end and a distal end, and an elongated electrically conductive shaft internally disposed within the length of the housing. The proximal end is attached to an apex locator and the distal end acts a probe tip. The housing is constructed of a hydrophilic polymer for surrounding the conductive shaft to minimize or eliminate electrical interferences thus avoiding the risk of over or under filling of a canal during endodontic treatment.

Accordingly, it is a primary objective of the instant invention to provide an improved endodontic point device for use in measuring the length of a root canal while minimizing or eliminating electrical interference from prior restorative work or anatomical variants.

It is a further objective of the instant invention to provide an improved endodontic point device which may be easily and effectively introduced into the narrow space of a root canal.

It is yet another objective of the instant invention to provide an improved endodontic point that minimizes or eliminates over or under filling of a canal during the endodontic treatment.

It is yet another additional objective of the instant invention to provide an improved endodontic point having a conical shape, the proximal end with a diameter

of approximately 1.5mm and the distal end with a diameter of approximately 0.2mm; and an approximate length of 25mm.

It is further an objective of the instant invention to provide an electrical conductor constructed of a non-corrosive and non toxic material, such as gold or grapheme.

It is a still further objective of the instant invention to provide an endodontic point housing constructed of a hydrophilic polymer for surrounding the conductive shaft.

It is an additional objective of the instant invention to provide an improved endodontic point device having a distal and a proximal end which can be trimmed in length at either end. Additionally, the ends can be filed to provide a suitable shape for intended use.

It is a still yet another objective of the instant invention to provide an endodontic point which could potentially be used as a permanently implanted endodontic point or for temporary fitment into the root canal.

It is yet another objection of the instant invention to a provide an endodontic point which is not only suitable for single cone technique, but also capable of replacing the multiple cone techniques, such as vertical or lateral compaction, which are known in the art.

Other objectives and advantages of this invention will become apparent from the following description taken in conjunction with any accompanying drawings wherein are set forth, by way of illustration and example, certain embodiments of this invention. Any drawings contained herein constitute a part of this specification and include exemplary embodiments of the present invention and illustrate various objects and features thereof.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 is a cross-sectional front view of the improved endodontic point;

Figure 2 is pictorial representation of the improved endodontic point in use; and

Figure 3 is a cross-sectional front view of an alternative embodiment of the endodontic point.

DETAILED DESCRIPTION OF THE INVENTION

As shown in Figures 1 and 2, an improved endodontic point 1 for use in endodontic therapy is disclosed. The improved endodontic point 1 comprising of an endodontic housing 10, constructed of hydrophilic polymer (such as zirconium dioxide), having a proximal end 12 and distal end 14. The distal end 14 includes a tapered end 16 for insertion into a root canal. The distal end 14 can be altered, filed, or cut to make for a better insertion tool within the root canal. The proximal end 12 is capable of being grasped by the user and is the handle portion. The proximal end 12 can also be altered, filed, or cut. The endodontic point 1 has a conical cross-section. An oval cross-section is contemplated for use in oval canals, not shown. The proximal end 12 has a diameter of approximately 1.5mm and the distal end 14 has a diameter of approximately 0.2mm. The endodontic point 1 has an approximate length 18 of 25mm.

Internally disposed within the endodontic housing 10 is an elongated electrically conductive shaft 20. The electrical shaft 20 is preferable constructed of a gold filament or grapheme. Other construction material considerations include any conductive, non-corrosive, and non-toxic materials. The electrical shaft 20 extends along the internal length 18 of the endodontic shaft 10. On the proximal end 12 a connection site 22 is located.

The connection site 22 creates an electrical connection with the electrical shaft 20 and an apex locator 30, discussed in detail later. On the distal end 14, the electrical shaft 20 extends at least flush with the leading edge of the endodontic shaft 10 so when the endodontic point 1 makes contact with the apical tissue the electrical shaft 20 is also making contact. The contact between the shaft 20 and the tissue will register a reading on the apex locator. Because of the material considerations, the endodontic point 1 could potentially be used as a permanently implanted endodontic point or for temporary fitment into the root canal.

As shown in Figure 2, the proximal end 12 is attached to an apex locator 30 and the distal end 14 acts as a probe tip to measure the length of a root canal, minimizing or eliminating electrical interference from prior restorative work or anatomical variants. The distal end 14 can be easily and effectively be introduced into the narrow space of a root canal, and thus minimizing or eliminating the over or under filling of a canal during the endodontic treatment. The improved endodontic point 1 has a connection assembly with an apex locator 30 wherein the connection is made at the proximal end 12. The proximal end 12 provides a connection site 22 for a connector means for an electronic apex locator 30. The connector includes a conductor such an electrical shaft 20; however, any connector means that securely attaches to the proximal end 12 of the endodontic point 1 is suitable, such as a spring clip, clasp, soldering method, or the like. The connection wire 32 is in electrical communication with the elongated electrically conductive shaft 20 located within the

endodontic point 1. A second connection wire 32 attached to the apex locator 30 is used a ground and is typically attached within the mouth of the patient 34.

The endodontic point 1 eliminates the risk of over-extension as well as under-filling by eliminating the compaction steps altogether, and providing a single continuous piece of filling material, the risks are eliminated. The endodontic point 1 can be precisely cut to a specified length and inserted without compaction. As discussed prior, known endodontic measurement techniques (using an apex locator) obtain the root canal length measurement by means of attaching the apex locator to a conducting instrument which is then inserted into the canal, then slowly pushed toward the end of the root until the apex locator signals that the apical foremen has been reached, and the apex locator precisely informs the endodontist of the canal length through a digital or analog display. The endodontist must then transfer this working length to the compacting and filling instruments by means of a ruler and then fit a collar to the instrument at the working length distance in order to provide a reference point.

The endodontic point 1 provides a single piece of conductive filling material that directly connects to the apex locator 30. This eliminates the need to transfer the working length information to a separate instrument and eliminates the indirect nature of the instrument calibration (the instrument is marked to length with the intention that the compaction will then not over fill the canal). The indirect nature of the current measurement techniques is a contributing factor to the situation that over extensions are fairly common outcomes of root canal treatments.

By connecting the endodontic point 1 to the apex locator 30, the endodontic point 1 can enable the apex locator 30 to signal when the endodontic point 1 is in the precise and ideal position. The endodontist thereby inserts the gutta-percha or other filling material into the root until the endodontic point 1 and apex locator 30 indicates the idea position. This permits the filling material to self-locate and eliminates the inaccuracies of measurement transfers from an apex locator to an endodontic probe, known in the prior art, and then the reliance on a measured instrument to affect the actual measured fill of the root canal. In effect, the endodontic point 1 twice removes the final result from the reading of the apex locator, eroding the accuracy twice. The endodontic point 1 directly informs the dentist where to locate the filling.

As shown in Figure 3, an alternative embodiment, between the endodontic point 1 and the electrical shaft 20 is a nylon coating 40. The nylon coating 40 surrounds the electrical shaft 20 and is bonded thereto. Bonded to the outer surface of the nylon coating 40 is the hydrophilic coating.

All patents and publications mentioned in this specification are indicative of the levels of those skilled in the art to which the invention pertains. All patents and publications are herein incorporated by reference to the same extent as if each individual publication was specifically and individually indicated to be incorporated by reference.

One skilled in the art will readily appreciate that the present invention is well adapted to carry out the objectives and obtain the ends and advantages mentioned, as well as those inherent therein. The embodiments, methods, procedures and techniques described herein are

presently representative of the preferred embodiments, are intended to be exemplary and are not intended as limitations on the scope. Changes therein and other uses will occur to those skilled in the art which are encompassed within the spirit of the invention and are defined by the scope of the appended claims. Although the invention has been described in connection with specific preferred embodiments, it should be understood that the invention as claimed should not be unduly limited to such specific embodiments. Indeed, various modifications of the described modes for carrying out the invention which are obvious to those skilled in the art are intended to be within the scope of the following claims.

CLAIMS

What is claimed is:

Claim 1. An electrically conductive dental endodontic point comprising of:

an endodontic point housing constructed an arranged for insertion into a space provided by a conventional root canal, said endodontic point housing further defined by a proximal end and a distal end forming a length therebetween with an elongated electrically conductive shaft centrally disposed and internally extending between said proximal and distal ends;

whereby said proximal end is attached to an apex locator and said distal end acts a probe tip to measure the length of a root canal upon insertion into the root canal, said housing minimizing electrical interference from prior restorative work or anatomical variants to obtain an accurate canal length providing precise filling of the canal during endodontic treatment.

Claim 2. The electrically conductive dental endodontic point according to Claim 1, wherein said endodontic point housing is non-conductive.

Claim 3. The electrically conductive dental endodontic point according to Claim 1, wherein said endodontic point housing is conically shaped, said proximal end larger than said distal end.

Claim 4. The electrically conductive dental endodontic point according to Claim 2, wherein said proximal end has an approximate diameter of 1.5mm and said distal end has an approximate diameter of 0.2mm.

Claim 5. The electrically conductive dental endodontic point according to Claim 1, wherein said endodontic point housing has a length of approximate 25mm.

Claim 6. The electrically conductive dental endodontic point according to Claim 1, wherein said endodontic point housing is constructed from a hydrophilic material.

Claim 7. The electrically conductive dental endodontic point according to Claim 1, wherein said elongated electrically conductive shaft is constructed of a non-corrosive and non toxic material.

Claim 8. The electrically conductive dental endodontic point according to Claim 1, wherein said elongated electrically conductive shaft is gold.

Claim 9. The electrically conductive dental endodontic point according to Claim 1, elongated electrically conductive shaft is grapheme.

Claim 10. The electrically conductive dental endodontic point according to Claim 1, wherein said length of said endodontic point can be altered by removing said distal end.

Claim 11. The electrically conductive dental endodontic point according to Claim 1, wherein said length of said endodontic point can be altered by removing said proximal end.

Claim 12. The electrically conductive dental endodontic point according to Claim 1, wherein said distal and said proximal end is adjustable to provide a suitable shape entry into a root canal space.

Claim 13. The electrically conductive dental endodontic point according to Claim 1, wherein said proximal end includes a connection site wherein said electrical shaft makes electrical connection with an electronic apex locator.

Claim 14. The electrically conductive dental endodontic point according to Claim 1, wherein said electrical shaft includes a nylon coating along an outer surface of said electrical shaft.

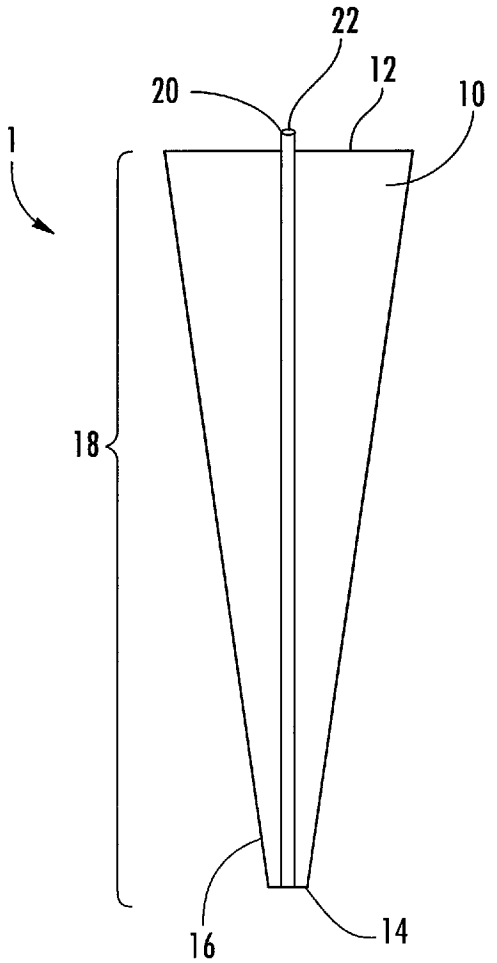

FIG. 1

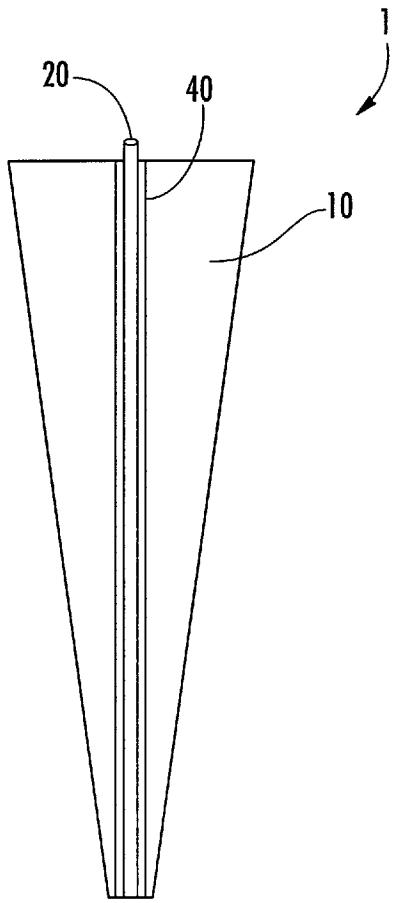

FIG. 3

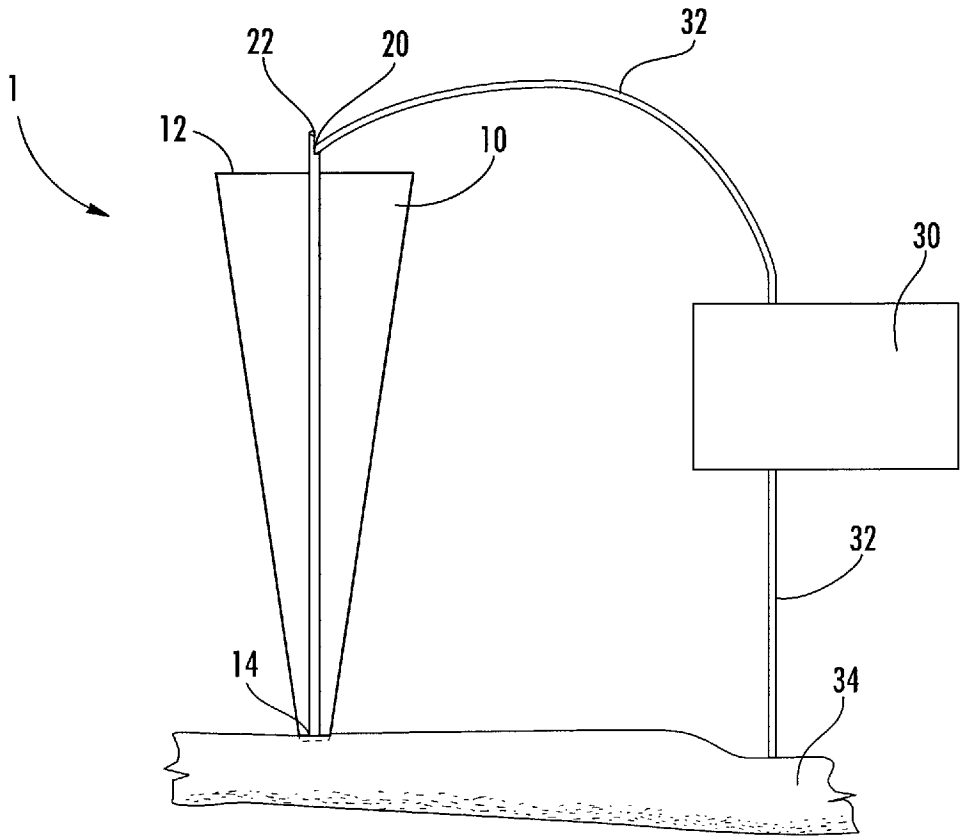

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/042706

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61C19/04
ADD.

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)
A61C

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)
EPO-Internal, WPI Data, COMPENDEX, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	EP 1 219 261 A2 (PINA LOPEZ JUAN CARLOS [ES]) 3 July 2002 (2002-07-03) paragraphs [0010] - [0015]; figures 1-7	1-5,7-13 6,14
Y	GB 2 139 898 A (HIGHGATE DONALD JAMES) 21 November 1984 (1984-11-21) pages 1-3; figures 1-2	6
Y	JP 2005 176914 A (IDM KK) 7 July 2005 (2005-07-07) paragraphs [0035] - [0077] figures 1-18	14

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

☒ See patent family annex.

* 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
9 August 2013	20/08/2013

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Pisseloup, Arnaud

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2013/042706

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