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Brainin

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[54] TOOTH REPLACEMENT

[75] Inventor: **Herbert Brainin**, Los Angeles, Calif.

[73] Assignee: **Vitredent Corporation**, Los Angeles, Calif.

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[51] Int. Cl.A61c 13/00

[58] Field of Search32/10 A; 128/334 R

[56] References Cited

UNITED STATES PATENTS

3,526,005 9/1970 Bokros.....128/334 R

3,526,906 9/1970 Delaszlo.....128/534 R X
2,210,424 8/1940 Morrison.....32/10 A

FOREIGN PATENTS OR APPLICATIONS

540,713 3/1956 Italy.....32/10 A
1,083,769 9/1967 Great Britain.....32/10 A

Primary Examiner—Robert Peshock

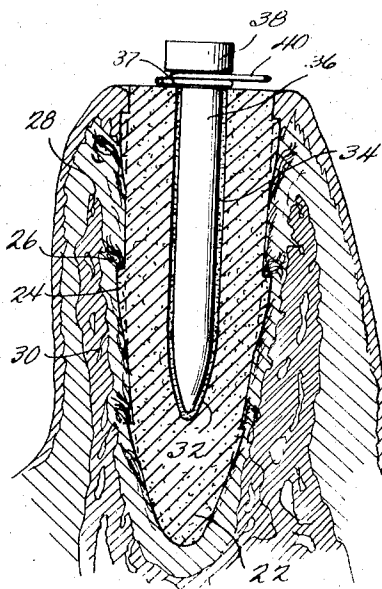
Attorney—John Kurucz

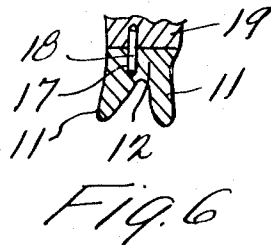
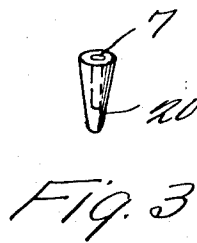
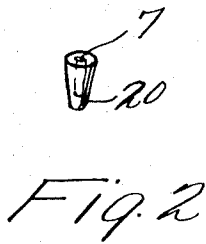
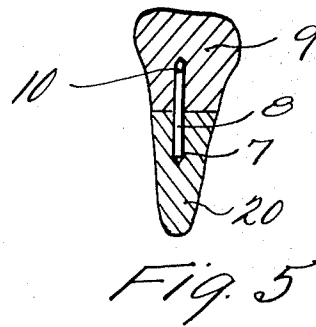
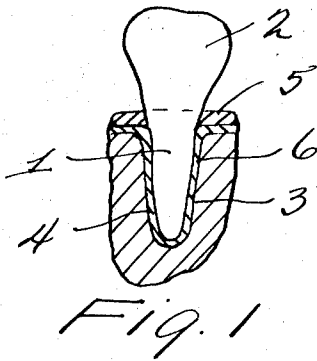
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ABSTRACT

A dental implant member for attachment to an artificial-tooth crown consists of or is externally coated with an impermeable carbon. The implant is preferably cone shaped and most preferably has external splines along the length.

9 Claims, 12 Drawing Figures





INVENTOR
HERBERT BRANIN

BY
Cushman, Gentry & Cushman
ATTORNEYS

Fig 7

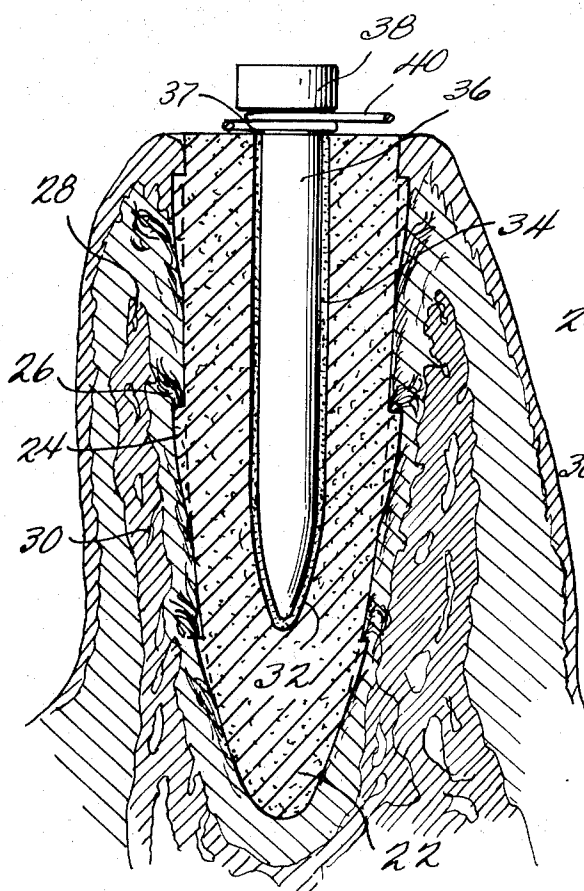


Fig 8

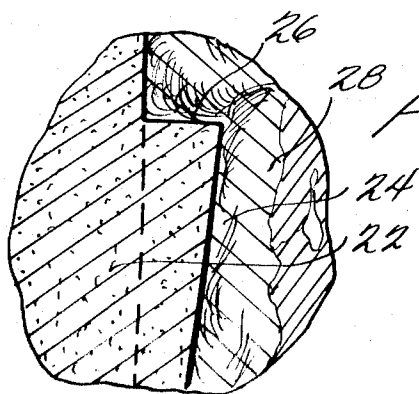
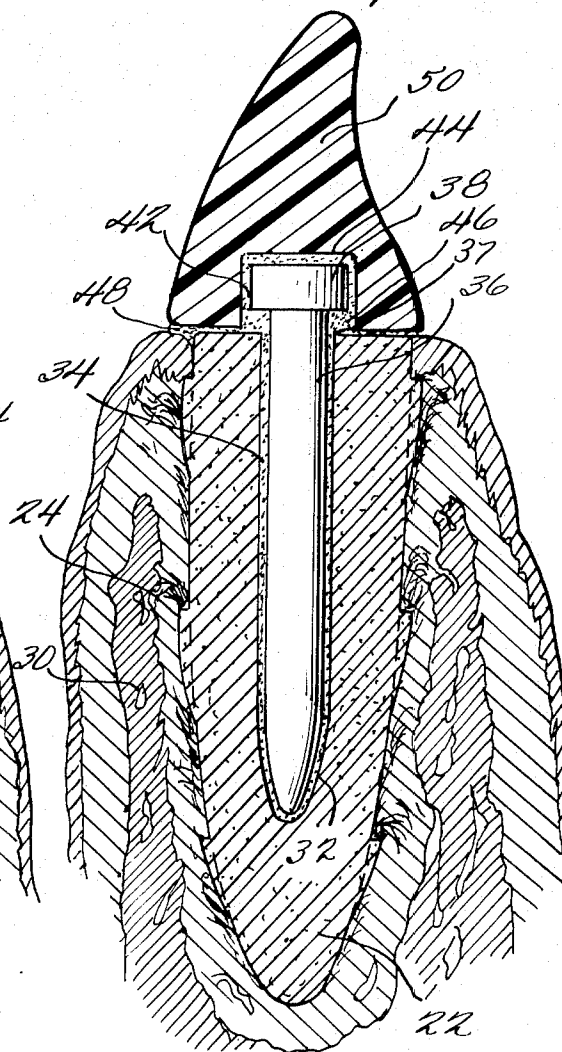


Fig 10

INVENTOR

HERBERT BRANIN

BY *Cushman, Shiley & Cushman*
ATTORNEYS

Fig. 9

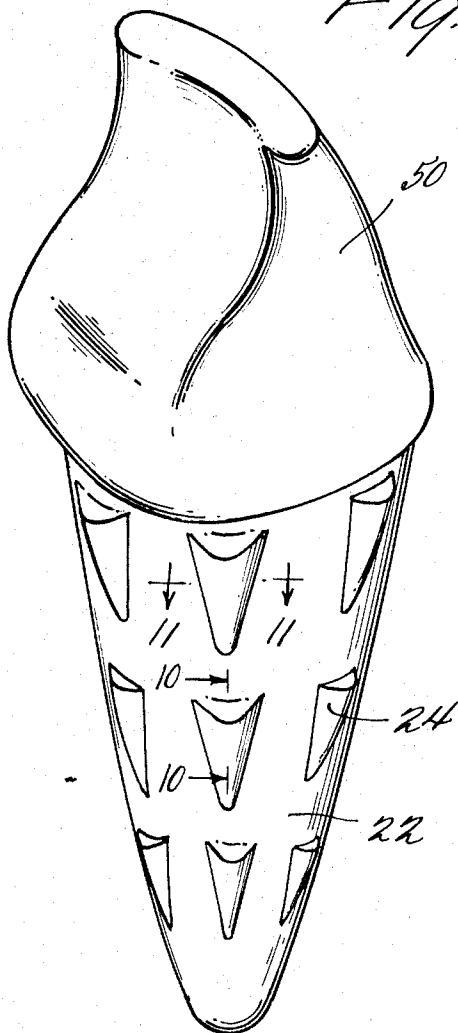


Fig. 12

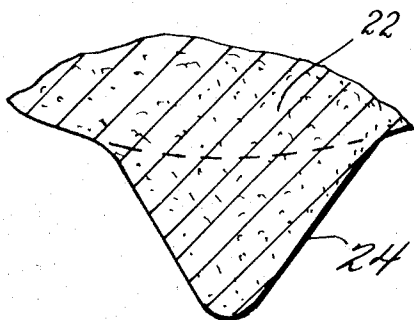
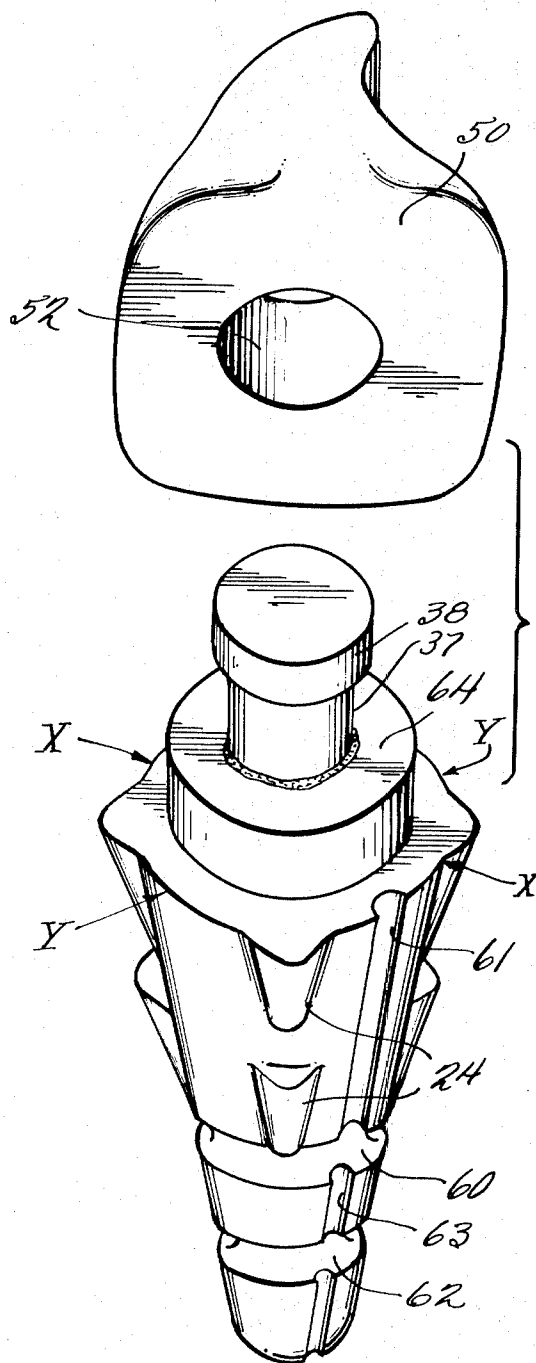


Fig. 11

INVENTOR

HERBERT BRANIN

BY *Cushman, Kaelin & Cushman*
ATTORNEYS

TOOTH REPLACEMENT

The present invention relates to a dental implant for insertion into an alveolus in the jaw of a vertebrate to form the root section of an artificial tooth.

It is known to form whole tooth implants from methyl methacrylate resin or copolymers of methyl methacrylate with methyl acrylate or ethyl acrylate. It is also known to make implants from such acrylic resins in admixture with approximately 20 percent grated organic calves' bone and these implants have had some success. In use, a regular periodontal membrane forms about the polymer implant between it and the alveolus into which it is fitted. Such implants have disadvantages due to the brittleness, lack of strength and cost of such resins.

It is an object of the present invention to provide a novel tooth implant.

Another object is to provide an artificial tooth implant of improved strength.

A further object is to prevent rejection of an artificial tooth.

It has now been found that these and the other objects of the invention which will become apparent hereinafter can be accomplished by providing a dental implant which is formed at least in part of a substantially impermeable carbon. Preferably the carbon is isotropic, microcrystalline in structure and, as stated, substantially impermeable. Such carbons are, for example, those known as vitreous, glassy, or pyrolytic carbons. They are chemically, biologically and physically compatible with animal tissue, nontoxic, noncarcinogenic and have been found ideally suited for use as a dental implant material, i.e. as a root section of an artificial tooth.

The solid vitreous and glassy chemically resistant carbon employed in the present invention are well known per se and are formed by the thermal degradation of organic materials. One process for producing such impermeable carbon bodies is described in Redfern U.S. Pat. No. 3,109,712 and British Pat. No. 956,452. The entire disclosure of these patents is hereby incorporated by reference. Such vitreous carbons in bulk form have a density of approximately 1.5, exhibit a chonchoidal fracture and are nonporous.

The pyrolytic carbons are also well known per se.

The solid impermeable carbon implants are formed in the desired shape, for example, by carbonizing a phenolformaldehyde resole or novolac as set forth in Redfern.

The invention provides: a dental implant for insertion into an alveolus in the jaw of a vertebrate, e.g. humans, dogs, cats, etc. to form the root section of an artificial tooth comprising a member having at least one generally cone shaped projection, and formed, at least in the part forming the surfaces engaging the alveolus, from a carbon which is isotropic, microcrystalline in structure, and substantially impermeable; and means for facilitating the securing of the member to a crown section of the artificial tooth. The crown section can be of any conventional material, e.g. an acrylic resin such as polymethyl methacrylate, methyl methacrylate copolymerized with methyl acrylate, ethyl acrylate, butyl acrylate, ethylene glycol dimethacrylate (ethylene dimethacrylate), vinyl-acrylic copolymer, nylon, polystyrene, etc. or porcelain.

Normally the root section will have one, two or three cones, depending upon the particular tooth which is being replaced.

The invention also provides an artificial tooth comprising: a crown section; a root section which is formed by a member having at least one substantially cone shaped projection and which is formed, at least in part, from a carbon material which is isotropic, microcrystalline in structure, and substantially impermeable, the root section being adapted to be inserted into an alveolus in the jaw of a vertebrate; and means for securing the crown section to the root section. Preferably the entire external portion of the root section exposed to the alveolus is of the carbon, which carbon, as stated is hard, vitreous, and chemically resistant.

As stated, the root section preferably has one, two or three conical external projections and is provided with an internal socket, which may or may not be cone shaped, for receiving the pin for joining the root section to the crown so that pressure is distributed evenly in all directions. Even when there are two or three cones in the root section there need only be one pin receiving socket. In practice, the dentist will be provided with a series of cones of various sizes to take care of the different sized alveolus encountered in practice. He also will be provided with one, two or three coned root sections to take care of the several types of teeth.

It has further been found that the bone structure and tissues will grow around the carbon root section and adhere thereto. To improve the retention of the artificial tooth and prevent rejection thereof, it has proven desirable to provide the carbon root section with at least one and preferably a plurality of external longitudinal splines, e.g. 2, 4, 6, 9 or 12. The shoulders of the splines aid in prevention of rejection of the artificial tooth because the tissue grows over the shoulder and helps fasten the root section in the jaw.

The cone shaped root section is easy to put in place. For example, the patient can put it in place himself simply by biting down on the root section, or the dentist can use a tool to put it in place.

The foregoing and other features according to the invention will be better understood from the following description with reference to the accompanying drawings, in which:

FIG. 1 diagrammatically illustrates a partly cross-sectioned side elevation of an incisor tooth fitted into an alveolus in the jaw of a vertebrate;

FIG. 2 diagrammatically illustrates a pictorial view of a dental implant which forms the root section of a mandibular central tooth;

FIG. 3 diagrammatically illustrates a pictorial view of a dental implant which forms the root section of a lateral incisor tooth;

FIG. 4 diagrammatically illustrates a pictorial view of a dental implant which forms the root section of a cuspid tooth;

FIG. 5 diagrammatically illustrates a cross-sectional side elevation of an artificial tooth;

FIG. 6 similarly illustrates an implant assembly for a bicuspid tooth;

FIG. 7 is a partially cross-sectional view of an incisor root section and pin ligated in place;

FIG. 8 illustrates the finished artificial incisor tooth in place;

FIG. 9 illustrates a preferred form of artificial tooth according to the invention;

FIG. 10 is a sectional view taken along the line 10—10 of FIG. 9 and showing the artificial tooth in place;

FIG. 11 is a sectional view taken along the line 11—11 of FIG. 9; and

FIG. 12 is an exploded view of the preferred form of root section, connecting pin and crown.

In man there are thirty-two permanent teeth, sixteen in each jaw. Each lateral half of each jaw contains two incisors, one canine, two premolars or bicuspsids, and three molars. The invention can be used to prepare an artificial tooth replacement for any of these natural teeth.

As shown in FIG. 1, which diagrammatically illustrates a partly cross-sectioned side elevation of an incisor tooth in position in the jaw of a vertebrate, the tooth basically consists of a root section 1 and a crown section 2.

The root section 1, which is substantially conical in shape, fits into an alveolus 3 in the bone of the jaw 4 of the vertebrate. The jaw bone is covered by a gum 5, and a periodontal membrane 6 is formed about the root section, i.e. between the alveolus 3 and the root section 1.

The crown section 2 projects above the jaw 4 and is used in mastication.

The canine tooth, like the incisor tooth, has a single substantially cone-shaped root section but the premolar and molar teeth have either two or three roots each of which is also substantially conical in shape.

It should, however, be noted that the root sections of the various types of teeth, whilst being substantially conical in shape, nevertheless have individual profiles.

Dental implants for replacing the root sections of mandibular central, lateral incisor, cuspid and bicuspid tooth structures are illustrated in FIGS. 2 to 5 of the drawings respectively. These implants are formed from a carbon material 20, for example vitreous carbon, which is isotropic, microcrystalline in structure, and substantially impermeable, and which, as stated in a preceding paragraph, is compatible with animal tissue and therefore ideally suited for this purpose.

The solid vitreous and glassy carbon implants of FIGS. 2 to 4 as previously set forth are conveniently formed by the thermal degradation of organic materials.

A solid impermeable carbon implant is formed by carbonizing an organic compound, for example, as described in one of the above-mentioned patents. Alternatively, the implants of FIGS. 2 to 5 can be formed by externally coating a root section of another material, for example a ceramic material, with pyrolytic carbon by a similar method. It would, of course, be necessary in this instance for the dimensions of the section being coated to be less than the required dimensions for the final root section by an amount equivalent to the desired thickness of the coating of pyrolytic carbon material.

The dental implants illustrated in FIGS. 2 to 5 which are each conical in shape, each have a blind hole 7 formed in the base thereof so that it opens in a direction facing away from the apex of the cone. The hole 7 is used, in a manner to be subsequently outlined, for securing the implant to a crown section.

In the implant assembly shown in FIG. 6, the implant has two conical cusps 11 joined by a portion 12, with a blind hole 17 in or near this junction portion 12.

In practice, before extraction of a natural tooth, the root size and shape of the tooth are determined by X-ray examination and a profile to replicate that of the root section of the natural tooth is formed from a vitreous carbon implant blank, for example, any one of the dental implants illustrated in FIGS. 2 to 4, by a grinding operation using a diamond wheel. Thus the thickness of the external coating of a pyrolytic carbon coated root section must be such that it can accommodate this grinding operation without exposing the underlying material.

As soon as the natural tooth is extracted, the prepared dental implant is inserted into the alveolus and is fixed in position by means of splints or ligates attached to the nearest neighboring teeth. If desired, a temporary stub-like portion 19 may be secured for this purpose to the implant, for example by a screw pin 18, as indicated in FIG. 6.

The periodontal ligament tends to attach at the dental implant with the result that the implant becomes firmly fixed in position within a period of time of the order of 4 to 10 weeks. The splints can then be removed.

At this stage, the new or artificial root section can, after removal of the temporary portion 19 if provided, be crowned, for example, as illustrated in FIG. 5 with a gold peg 8 and a plastic cap 9, e.g. of polymethyl methacrylate, as if it were a natural root. The gold peg 8 which is secured within a hole 10 in the plastic cap 9, is so arranged that it fits into the hole 7 in the dental implant and can be secured to the implant in any convenient fashion, e.g., with dental cement.

The carbon implant may be roughened as necessary to assist in the attachment of the periodontal ligament thereto.

More complex root shape, for example those of the premolar, may be made by machining from solid resin, allowance being made for the shrinkage which occurs during the carbonization process in which the resin is converted to carbon.

Edentulous regions of the jaw may have sockets prepared by surgical means prior to implantation.

As shown in FIG. 7, the substantially impermeable, vitreous carbon root section 22 is of conical shape and is provided with a series of external longitudinal splines 24. Each spline terminates in an upper outwardly extending shoulder 26 which aids in preventing rejection of the artificial tooth since the tissue or periodontal membrane 28 grows over and around the spline. The alveolar bone is shown at 30.

The carbon root section 22 has a central conically shaped opening or socket 32. A connective pin 36 is fitted into the socket and secured to the vitreous carbon root section 22 by the dental cement 34 is applied to the surface of the socket 32. The pin can be made of metal such as gold, stainless steel, titanium steel, or even of a plastic if it has sufficient strength. The pin terminates in an enlarged cylindrical head 38. The pin is slightly longer than the socket as shown in FIG. 7, 8 and 12. A wire 40 can be looped around this projecting section 37 below the head 38 and employed to ligate the root section to adjacent anchor teeth in conventional manner until bonding between the jaw bone and the

vitreous carbon cone takes place. Then the wire is removed and the exposed portion of the connective pin coated with dental cement as at 42, 44, 46 and 48 (see FIG. 8) to secure a conventional cap or crown 50, e.g., an acrylic crown such as a polymethyl methacrylate crown, to the connective pin and root section 22. The crown section 50 has a central opening 52 (see FIG. 12) over the head 38 of the pin. FIG. 11 shows the alveolus 54 for receiving the root section 22 of the artificial tooth.

FIG. 12 shows another preferred embodiment of the invention wherein splines 24 may, at least in part, terminate at their lower extremities adjacent a lateral recess 60 which lateral recess serves to improve the securing of the implant by means of the tissue growing about the splines and into the recess. The dimensions of the lateral recess are not critical, as is true for the dimensions of the splines. However, it is convenient that the recesses extend into the conical member at least one-fiftieth of the greatest longitudinal cross-section dimension of the conical member and have a longitudinal dimension (in the direction of the center line of the conical section) at least one one-hundredth of the longitudinal dimension of the implant. The recess may be of a shape that is generated by a single dimension radius or multiple radii or may be angular if desired, e.g., circular, oval, an angle. Likewise, the splines may be so configured as to have a plurality of planar surface, e.g., formed by the intersection of two, three, four etc., planes, or they may not have any planar surface at all and may be simply a shape defined by a plurality of tangent lines. It should also be understood that the splines need not be tapered toward the apex of the conical implant, but they may be oppositely tapered, or they may have no taper at all in comparison with the outside surface of the implant. Hence, a regular conical shape (surface) may simply be ground, machined, etc. to form a plurality of lateral and longitudinal recesses, as noted above, which will form not only the discussed recesses, but the splines as well. Or the resulting splines may be additionally shaped to the configurations noted above. Additionally, the splines may form a single member extending from near the top portion of the conical member to near the apex of the conical member, instead of the plurality of splines along the center line of the conical implant as shown in the drawings, although the latter is preferred.

As shown in FIG. 12, the implant may also have longitudinal recesses 61 which may extend substantially the entire length of the conical section or a portion thereof and the shape of the longitudinal recess may be substantially the same as described in connection with the lateral recesses. The implant may have a plurality of such longitudinal recesses.

It is additionally preferred that near the apex of the conical implant there is disposed at least one lateral recess 62, since a recess in this lower portion will substantially reduce hydraulic pressure on the implant during growth of the tissue thereabout. Preferably this recess will entirely circumscribe the surface of the implant, i.e., extend all the way around the implant. Optionally, recess 62 may be connected to an above recess e.g., recess 60, by a longitudinal recess portion 63 which further relieves hydraulic pressure.

It should be appreciated that the lateral cross-sectional shape of the conical implant need not be strictly circular, but may be otherwise shaped and especially oval shaped. Hence, the dimensions of X—X and Y—Y (through the center line of the conical implant) may be the same (a circular shape) or different (an oval shape). For some alveolus, the oval shape of the implant is preferred since the oval shape follows more closely the actual shape of the alveolus. For example, the ratio of dimension of X—X/Y—Y may be from 1:1 to about 1:1.5, although ratios smaller than 1:1.5 are preferred, e.g., about 1:1.1 to 1:1.3. If desired the head portion 38 and/or shoulder portion 64 may be similarly oval shaped, which will prevent any rotating motion of crown 50 when central opening 52 is similarly oval shaped.

The advantages of the carbon root sections are that they are mechanically stronger than ones made of plastic material and have less tendency to deform by the pressures exerted by the jaws during mastication. These root sections are also more readily held in place than a complete plastic tooth and less expensive to manufacture and the carbon materials specified above are more chemically resistant than plastics.

It is to be understood that the foregoing description of specific examples of this invention is made by way of example only and is not to be considered as a limitation on its scope.

As stated, any conventional dental cement can be used to bond the pin to the root section and the crown section, to bond the crown section to the root section and to bond the root section to the well of the alveolus. Thus there can be used zinc phosphate, zinc oxide-eugenol, silicate, zinc silicate or acrylic resin (e.g., methyl methacrylate polymer cements).

What is claimed is:

1. A dental implant for insertion into an alveolar cavity in the jaw of a vertebrate to form the root section of an artificial tooth comprising: a member having a shape generally corresponding to said cavity and being capable of being inserted in said cavity and formed, at least in the portion forming the surfaces for engagement with the alveolus, from a carbon material which is chemically, biologically and physically compatible with tissues of the oral cavity of vertebrates, said carbon material being isotropic and microcrystalline in structure and being selected from the group consisting of vitreous, glassy and pyrolytic carbons; and means for facilitating the securing to the member of a crown section forming with said member the artificial tooth.

2. A dental implant as claimed in claim 1 wherein the entire root section is said carbon material.

3. A dental implant as claimed in claim 1 wherein only the outer layer of the member is of carbon material, the remainder of the member being of a material other than the said carbon material.

4. A dental implant as claimed in claim 1 wherein the root section forms part of an artificial tooth which includes a crown section, and means for securing the crown section to the root section.

5. A dental implant as claimed in claim 1 wherein the member has at least one substantially cone-shaped projection which defines the surfaces for engagement with the alveolus.

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6. A dental implant as claimed in claim 1 wherein more than one substantially cone-shaped projection is provided for supporting a crown section of the artificial tooth and defines the surfaces for engagement with the alveolus.

7. A dental implant as claimed in claim 1 wherein a plurality of longitudinally extending external carbon splines form part of the implant for aiding in per-

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manently securing the root section in place.

8. A dental implant as claimed in claim 1 wherein the surface of the carbon material has a roughened surface, said roughened surface assisting in the attachment of the periodontal ligament thereto.

9. A dental implant as claimed in claim 1 wherein the carbon material is substantially impermeable.

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