Sept. 23, 1969 R. A. SUNTER 3,468,028

ARTIFICIAL CROWNS FOR TEETH

Filed Oct. 9, 1964 2 Sheets-Sheet 1

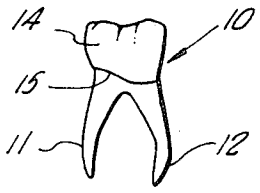


FIG. 1

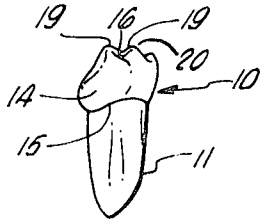


FIG. 2

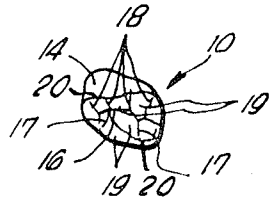


FIG. 3

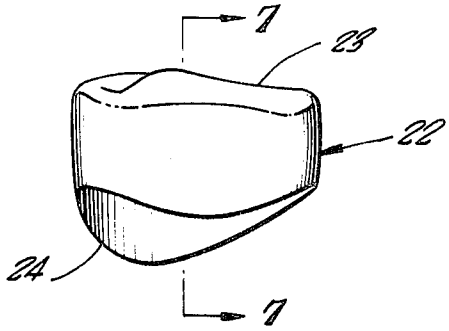


FIG. 4

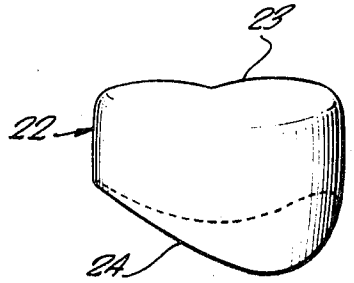


FIG. 5

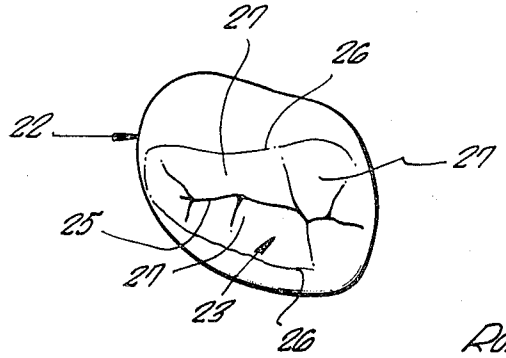


FIG. 6

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ARTIFICIAL CROWNS FOR TEETH

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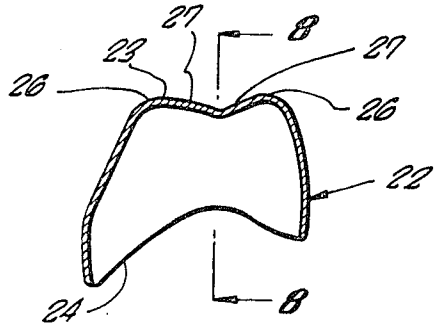


FIG. 7.

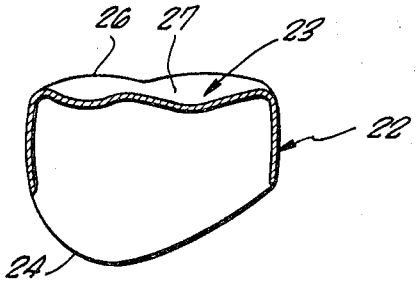


FIG. 8.

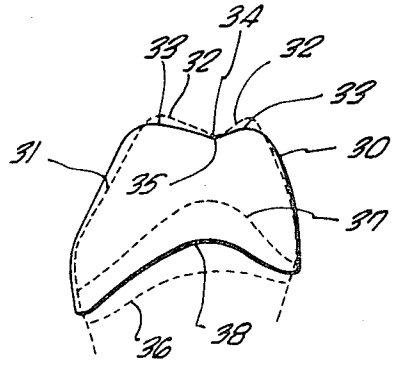


FIG. 9.

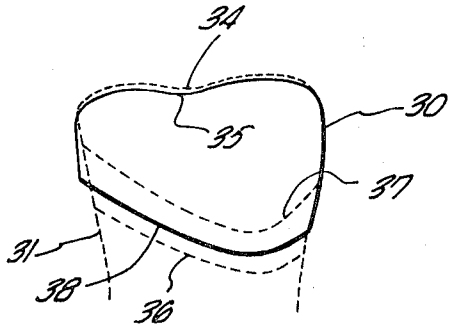


FIG. 10.

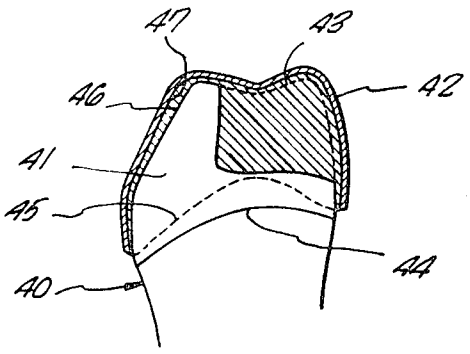


FIG. 11.

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ARTIFICIAL CROWNS FOR TEETH

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Int. Cl. A61c 5/08
U.S. Cl. 32—12 8 Claims

ABSTRACT OF THE DISCLOSURE

A preformed artificial crown for restoring a damaged tooth, the crown having an occlusal surface with cuspal planes oriented at cuspal angles substantially smaller than the cuspal angles of the natural tooth being restored. The height of the crown and contour of the crown gingival edge are selected to position the crown edge between the gingival and cervical lines of the damaged tooth with little or no custom trimming by the dentist. A broadened occlusal table on the crown minimizes the removal of health structure from the tooth being restored.

This invention relates to improved artificial crowns for the enclosure and preservation of damaged, decayed, and, in general, physiologically unsound teeth. The practice of restoring teeth with complete caps or crowns is generally applicable to the first and second primary molars and the first permanent molars. Although artificial crowns may also be used for permanent bicuspid teeth, use on the identified molars is so predominant that they are referred to in the profession as "molar crowns," which terminology is adhered to in this specification.

Molar crowns are used primarily in pedodontics to enable a child to retain a badly damaged primary tooth until such time as it is naturally replaced by a permanent tooth. Even though a tooth is damaged by excessive decay or accident, it is much better that the tooth, suitably restored by means of a molar crown, remain in place for chewing and for retention of proper tooth spacing necessary to healthy replacement by the permanent teeth. For this reason, the practice of capping decayed or damaged tooth has become prevalent where, for one reason or another, the tooth is too weak or too badly decayed to restore by simple amalgam fillings.

At the present time there are available to the profession a number of molar crowns for this purpose. However, without exception, presently available crowns are difficult to use and improperly designed to accomplish optimum results.

The configuration of the teeth of different persons differs in some degree. Therefore, in teaching dentistry and designing dental and orthodontic appliances and in developing molar crowns one attempts to use a composite tooth for each tooth position as a frame of reference. A recognized authority on this subject is Dr. Henry A. Linek, Associate Professor of Dental Anatomy, University of Southern California School of Dentistry, who, in his published Tooth Carving Manual, printed in U.S.A. by Wood and Jones, Pasadena, Calif., has illustrated composite teeth for every tooth position. The term "composite tooth" as used in this specification and the appended claims refers to the composite teeth in the Linek publication. The composite tooth, as the name implies, represents a composite of a large number of examples of the particular tooth in question. Previously available molar crowns have been provided with an occlusal anatomy duplicating as nearly as possible that of the corresponding composite tooth. For this very reason severe difficulties frequently result in the use of such crowns.

I have invented and developed an improved molar crown design, the principles of which are applicable to the several sizes and configurations that must be provided to accommodate the several teeth that may be crowned. During the process of growth and use of teeth, mating upper and lower teeth grind matching cuspal planes or facets which form bearing surfaces as the teeth are used. The normal individual can rotate his jaw within small limits even with his jaws closed, because a certain amount of sliding of these mating planes is possible. This sliding or gliding to either side from a centric bite position is referred to as sliding into lateral excursions. As the jaw moves into these lateral excursions, the individual teeth which oppose or mate with each other glide or rise along the opposing cuspal planes. I have found that the existing artificial crowns have occlusal surfaces with cuspal planes which are as steeply inclined as those of the composite examples of the tooth on which they are used. If the angle of the cuspal planes is greater than the angle of the cuspal planes of the patient's remaining unrestored teeth, then the patient will suffer from a lateral interference. With conventional structures, therefore, the likelihood of interference in the lateral excursions is high. These lateral interferences can, and often do, cause considerable discomfort to the patient and serious damage to the tooth bearing the restoration crown.

I have solved this problem, and in this regard one feature of my improved crown is the configuration of the occlusal anatomy purposely and markedly differing from that of the corresponding normal or composite tooth. I have determined that if the artificial crown is constructed so that its cuspal planes lie at an angle to the cuspal table not exceeding 75% of the cuspal angle of the corresponding tooth, proper engagement with the mating tooth is insured. In other words, if the cuspal angles of the crown restoration are appreciably less than the cuspal angle of the opposing unrestored tooth, objectionable lateral interference is prevented.

A further aspect of the improved molar crown of the invention is the configuration of the gingival extremity. It has heretofore been the practice to provide an excess gingival extension which must be trimmed by the dentist or pedodontist before the crown can even be placed on the tooth for proper sizing. I have determined that the proper crown anatomy of the gingival extension can be predetermined, again by reference to the composite structure of the respective tooth. If the gingival edge of the crown follows generally the median line between the gingival line and the cervical line of the tooth, it affords not only the greatest possible protection to the tooth but also greatly simplifies the dentists' job of fitting. The crown having this anatomy of the gingival extension will, in many cases, fit without trimming and in substantially all other cases will need only a very minimum of trimming. At the same time, it is insured that the crown extends into the so-called physiologically clean area lying between the gingival line and the epithelial line, the latter being the definition of the locus of attachment of the gingiva to the tooth.

The invention will be more clearly understood by the following description of the appended drawings, in which:

FIG. 1 is an enlarged buccal elevation of a composite lower right first deciduous molar;

FIG. 2 is a mesial elevation of the same tooth;

FIG. 3 is an occlusal view of the same tooth;

FIG. 4 is a lingual elevation of a crown in accordance with the invention for application to the tooth shown in FIGS. 1, 2 and 3;

FIG. 5 is a buccal elevation of the crown of FIG. 4;

FIG. 6 is an occlusal plan view of the crown of FIG. 4;

FIG. 7 is a section taken on the line 7—7 of FIG. 4;

FIG. 8 is a vertical section of the crown of FIG. 4 taken on the line 8—8 of FIG. 7;

FIG. 9 is a diagram in mesial elevation of a crown as shown in FIG. 4 superimposed on a composite tooth, the crown being illustrated in solid line and the tooth in broken line;

FIG. 10 is a diagram in buccal elevation of a crown as shown in FIG. 4 superimposed on a composite tooth, the crown being illustrated in solid line and the tooth in broken line; and

FIG. 11 is a mesial elevation of a crowned molar with the crown broken away to expose the enclosed portion of the prepared tooth.

Referring to FIGS. 1, 2 and 3, there is shown in various views a composite lower right first deciduous molar **10** having roots **11**, **12** and the enamel-covered anatomical crown **14**. The enamel terminates at the cervical line **15**.

The occlusal surface of the tooth as shown most clearly in FIG. 3, includes a central sulcus or principal groove **16** and secondary or supplementary occlusal grooves **17** extending lingually and **18** extending buccally from the sulcus and bordering and defining the cuspal planes **19** which merge to the cuspal ridges or cusps **20**. In the mesial view of FIG. 2, the sulcus groove **16**, buccal and lingual cuspal planes **19**, and from this view the normal and relatively steep angular inclination of the cuspal planes with the occlusal table, may be observed. For purposes of definition, the occlusal table is considered to be the plane of the chewing surface of the tooth.

An artificial crown for use on the same tooth as shown in FIGS. 1 through 3 is illustrated in various views in FIGS. 4 through 8. It will be observed that the occlusal anatomy of the artificial crown in general conforms in the location of the sulcus groove, supplemental occlusal grooves, the cusps and the cuspal planes with occlusal anatomy of the illustrated tooth. However, there is one substantial and very important difference in that the topography of the occlusal surface of the artificial crown is considerably more gentle than that of the composite tooth as illustrated.

Referring to the figures, the crown **22** is in the nature of a cup-shaped cap having a closed end **23** forming the occlusal table and sides which terminate in what is referred to as a gingival extremity **24**. Referring particularly to the occlusal view of FIG. 6, the buccal-lingual section of FIG. 7 and the mesial-distal section of FIG. 8, the occlusal anatomy of the crown, as is the case with the tooth of FIGS. 1 through 3, includes a sulcus or central groove **25**, cusps **26**, and cuspal planes **27**, the cuspal planes being separated and defined by the sulcus and also by supplementary or secondary occlusal grooves extending both buccally and lingually from the sulcus. However, in the artificial crown the angular inclination of the cuspal planes **27** with respect to the cuspal table is purposely made less steep than that of the corresponding composite tooth, which difference may be clearly observed by comparing the generally corresponding views of FIGS. 2 and 7.

As explained above, I have discovered that the difficulty of achieving proper mating with an artificially crowned tooth can be virtually eliminated by restricting the angular inclination of the cuspal planes of the artificial crown to less than 75% of the inclination of the corresponding cuspal planes of the composite tooth for which the crown is designed. Best results are obtained if this proportion is in the region of 45% to 60% of the composite tooth.

It is here important to note that a crown with too little cuspal topography, i.e. with cuspal planes of less than approximately 40% to 45% of the angular inclination from the cuspal table of the corresponding cuspal planes of a composite tooth, will not result in an adequate mating in the lateral excursions to accomplish adequate food flow and mastication. Accordingly, it is important that the artificial crown have an occlusal configuration or topography which produces the necessary grinding action for mastication and, in accordance with the present invention, that it be attenuated from that of the corresponding composite tooth to the extent indicated to avoid, at the same time, painful and harmful lateral interferences.

FIG. 9 is a diagram of the crown of FIG. 4 in mesial view superimposed on a reproduction of the tooth of FIG. 2, also a mesial view. In FIG. 9, the crown is shown in solid line and identified by the reference numeral **30**, and the tooth is illustrated in dotted line and identified by the reference numeral **31**. From this diagram, the relationships of the occlusal topography or anatomy of the tooth or the crown, as discussed in detail above, is also quite apparent, cusps **32** of the tooth extending well above cusps **33** of the crown even though the sulcus groove **34** of the tooth generally coincides with the sulcus groove **35** of the crown.

Turning to another aspect of the improved crown of the invention, the cervical line of the tooth is identified at **36** and the gingival line at **37** in FIGS. 9 and 10. The gingiva or gum contacts the tooth at a point displaced toward the occlusal surface from the point of actual attachment of the gingiva to the tooth. The locus of this attachment is called the epithelial line (not illustrated), and the intervening region between the gingival and epithelial lines is a physiologically produced clean area. It is desirable that the artificial crown in all circumstances project into this clean area. To insure this end, and also to facilitate the application of these crowns by the dentist, I have found that both objectives can be accomplished if the gingival extremity or edge 38 of the crown is sculptured to follow closely the epithelial line or, in other words, an approximate median line between the gingival and cervical lines. As previously noted, by careful attention to this configuration, there are many instances in which the dentist need not alter this crown. Even where a significant departure of a given tooth from normal or composite configuration is encountered, only a minimum of trimming need be required to adapt this crown to the situation and, even in such circumstances, the crown will in all cases extend below the gingival line as is desirable,

As evident from the several figures, the gingival line is highly contoured and differs significantly on various aspects of the tooth. Thus the mesial gingival line (FIG. 9) differs considerably in contour on the tooth from the buccal gingival line (FIG. 10). To fabricate, therefore, a truly sculptured crown it is necessary, as illustrated, to contour its entire gingival edge with care and precision to the configuration dictated by composite anatomy.

The invention is not directly concerned with conventional procedures for tooth preparation or application of crowns. However, FIG. 11 is an elevation view of a crowned tooth with a portion of the crown cut away to show the normal relationship of crown and tooth. In this drawing, a tooth **40** with the usual anatomical crown **41** is provided with an artificial crown **42** in accordance with the invention. For purposes of illustration, the tooth **40** is shown as having a substantial removal of tooth structure necessary due to extensive decay. If the tooth structure removed is extensive, amalgam restoration techniques are not a practical method of restoration and the crown is indicated.

A tooth such as that shown in FIG. 11 is prepared by removing all decayed matter and the extreme peaks of the cusps, as required, and enough occlusal surface to allow for metal thickness of the crown, sterilizing the exposed surfaces and fitting and placing a crown over the major part of the anatomical crown, as illustrated. The artificial crown is positioned occlusally and secured to the tooth by a body of cement **43** which is initially soft so that the occlusal projection of the crown is determined by engagement with the mating tooth in the centric position.

In this manner, the crown seeks its proper level, the cement hardens, and the crown is in the permanent position.

By virtue of the occlusal anatomy of the artificial crown, as described in detail above, a proper mating with the corresponding tooth of the opposite jaw is achieved and, by virtue of the configuration of the gingival extremity of the crown, and again as described above, the crown will project into the physiologically clean area in the region of the epithelial attachment. In FIG. 11 the cervical line of the tooth **40** is at **44** and the gingival extremity of the crown at **45**. The gingival line of the tooth is not shown but lies above the gingival extremity **45** of the crown.

One other feature of the present crown which is unique in the present state of the art is illustrated in FIGS. 9 and 11 and involves the broadening of the occlusal table of the crown so that it is somewhat broader buccal-lingually than that of the corresponding tooth. In FIG. 11, this is illustrated by the space intervening between the buccal surface **46** of the anatomical crown and the inner buccal surface **47** of the artificial crown, which spacing in the figure is filled with cement. The purpose of this broadening of the occlusal table of the artificial crown buccal-lingually is to avoid the excessive grinding away of otherwise healthy tooth structure in order to secure clearance to fit the crown. Such destruction of normally healthy structure in the crown preparation is frequently required in using present crowns because they are made to taper more or less in conformity with the tooth shape itself and accordingly, as variations in tooth shape are encountered, a portion of the tooth around the periphery must be removed to accept the crown.

Where a tooth is being crowned because it is fundamentally in a weakened condition due to decay, any further weakening for the sole purpose of installing the crown is dangerous and objectionable. Accordingly, crowns in accordance with my invention are provided with an interior buccal-lingual dimension of the occlusal table of approximately 5% to 10% greater than the corresponding dimension of the respective composite tooth. This contrasts with previously available artificial crowns which tend toward a narrower buccal-lingual table than the respective tooth. In this fashion, I have found that the crown will fit substantially any tooth for which it is designed without requiring undesirable removal of the buccal and lingual tooth structure.

Briefly, I have departed from the normal concept of artificial crown structure which has been to pattern the occlusal table and cuspal planes and angles of the artificial crown after a typical or composite tooth as closely as possible and to make the gingival extension of such length shape as to always require extensive trimming and shaping. In contrast, I have developed a crown which is considerably superior both in application and in use to the conventionally available counterparts. Specifically, a crown in accordance with the present invention is provided with an occlusal anatomy which significantly differs from the corresponding anatomy of the respective tooth for which the crown is designed, the gingival extremity of the artificial crown is contoured to fall within a specified region of the anatomical crown, and the occlusal table of the crown is purposely enlarged in proportion to the occlusal table of the corresponding composite tooth.

In all of these respects the present crown represents an improvement in the art, facilitates the use by the dentist and produces improved results in operation.

I claim:

1. A preformed artificial crown for restoration of a tooth comprising a cup having an occlusal table and sides depending therefrom, the sides being of an overall respective length such that the crown terminates within the physiologically clean area between the gingival and cervical lines of a composite tooth corresponding to the tooth on which the crown is to be used, the occlusal table of the crown having a preformed anatomy in which a plurality of cusps are separated by a central sulcus and lingual and buccal grooves defining cuspal planes, the inclination of the cuspal planes from the occlusal plane of the crown being not in excess of approximately 75% of the inclination of the corresponding cuspal planes in said composite tooth, the occlusal table of the crown being from about 5% to about 10% broader in buccal-lingual dimension than said composite tooth.

2. A preformed artificial crown for restoration of a tooth comprising a cup having an occlusal table and sides depending therefrom, the sides terminating at the gingival extremity in a configuration generally conforming to the gingival line of a composite tooth corresponding to the tooth on which the crown is to be used, the sides being of an overall respective length such that the crown terminates within the physiologically clean area between the gingival and cervical lines of said composite tooth, the occlusal table of the crown having a preformed anatomy in which a plurality of cusps are separated by a central sulcus and lingual and buccal grooves defining cuspal planes, the inclination of the cuspal planes from the occlusal plane of the crown being from about 40% to about 75% of the inclination of the corresponding cuspal planes in said composite tooth.

3. A preformed artificial crown for restoration of a tooth comprising a metallic cup having an occlusal table and sides depending therefrom, the sides being of an overall respective length such that the crown terminates within the physiologically clean area and on a line approximately midway between the gingival and cervical lines of a composite tooth corresponding to the tooth on which the crown is to be used, the occlusal table of the crown being from 5% to 10% broader in the buccal-lingual dimension than said composite tooth and having a preformed anatomy in which a plurality of cusps are separated by a central sulcus and lingual and buccal grooves defining cuspal planes, the inclination of the cuspal planes from the occlusal plane of the crown being from about 40% to about 75% of the inclination of the corresponding cuspal planes in said composite tooth.

4. A preformed artificial crown for restoration of a tooth comprising a cup having an occlusal table and sides depending therefrom, the occlusal table of the cup having a preformed anatomy in which a plurality of cusps are separated by a central sulcus and lingual and buccal grooves defining cuspal planes, the inclination of the several cuspal planes thus defined from the occlusal plane of the crown being from about 40% to about 75% of the inclination of the corresponding cuspal planes of a composite tooth corresponding to the tooth on which the crown is to be used.

5. A preformed artificial crown for restoration of a tooth comprising a cup having an occlusal table and sides depending therefrom, the occlusal table of the cup having a preformed anatomy in which a plurality of cusps are separated by a central sulcus and lingual and buccal grooves defining cuspal planes, the inclination of the several cuspal planes thus defined from the occlusal plane of the crown being from about 40% to about 75% of the inclination of the corresponding cuspal planes of a composite tooth corresponding to the tooth on which the crown is placed, and the buccal-lingual dimension of the occlusal table of the crown being from about 5% to about 10% greater than the corresponding dimension of said composite tooth.

6. A method for making a preformed artificial crown for restoration of a natural tooth, comprising the steps of:

(a) measuring a composite tooth corresponding generally to the natural tooth being restored to determine angles of inclination of cuspal planes of the composite tooth with respect to an occlusal plane of the composite tooth; and

(b) forming an artificial crown from a cup having an

occlusal table and sides depending therefrom, the occlusal table being thereby contoured to define cuspal planes which are inclined to an occlusal plane of the crown from about 40% to about 75% of the measured inclination of the corresponding cuspal planes of the composite tooth.

7. The method defined in claim **6** and further comprising the steps of:

(a) measuring the composite tooth to determine its gingival-line contour and side length to a line approximately midway between its gingival and cervical lines; and

(b) forming the sides of the cup to correspond to the measured length and gingival contour of the composite tooth.

8. The method defined in claim **7** and further comprising the steps of:

(a) measuring the composite tooth to determine a buccal-lingual dimension of its occlusal table; and

(b) forming the occlusal table of the cup to be from about 5% to about 10% broader in buccal-lingual dimension than the measured buccal-lingual dimension of the composite tooth.

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ROBERT PESHOCK, Primary Examiner