633664

COMMONWEALTH OF AUSTRALIA

Patents Act 1952

CONVENTION APPLICATION FOR A STANDARD PATENT

I/WE, IVOCLAR AG.
of, Bendererstr. 2
FL-9494 Schaan
Principality of Liechtenstein

hereby apply for the grant of a Standard Patent for an invention entitled: " PROCESS FOR PRODUCING DENTAL RESTORATIONS AND A POSITIVE WORKING MODEL FOR IMPLEMENTING THE PROCESS "

which is described in the accompanying complete specification.

This application is made under the provision of Part XVI of the Patents Act 1952 and is based on an application for a patent or similar protection made

in FEDERAL REPUBLIC OF GERMANY on 16 DECEMBER 1989 (No. P 39 41 663.1)

My/Our address for service is:-

F.B. RICE & CO.
28A Montague Street
BALMAIN NSW 2041

Dated this 5th day of DECEMBER 1990.

IVOCLAR AG.

By: _____
Registered Patent Attorney

To: The Commissioner of Patents
COMMONWEALTH OF AUSTRALIA

Commonwealth of Australia
The Patents Act 1952

# DECLARATION IN SUPPORT

In support of the (Convention) Application made by: IVOCLAR AG
of Bendererstr. 2, FL-9494 Schaan, Principality of Liechtenstein

for a patent for an invention entitled: PROCESS FOR PRODUCING DENTAL RESTORATIONS AND A POSITIVE WORKING MODEL FOR IMPLEMENTING THE PROCESS

I~~x~~(We) Dr Volker and Roland Mann

of and care of the applicant company do solemnly and sincerely declare as follows:

~~a) I am (We are) the applicant(s) for the patent~~
or
b) ~~I am~~ (We are) authorised by the applicant(~~s~~) for the patent to make this declaration on its behalf.

Delete the following if not a Convention Application.

The basic application(~~s~~) as defined by section 141 (~~142~~) of the Act was (~~were~~) made

on 16 December 1989 in West Germany

~~on~~ ~~in~~

~~on~~ ~~in~~

by Ivoclar AG

The basic application(~~s~~) referred to in this paragraph is (~~are~~) the first application(~~s~~) made in a Convention country in respect of the invention the subject of the application.

~~a) I am (We are) the actual inventor(s) of the invention.~~

or
b) Volker Rheinberger of Floraweg 3, FL-9490 Vaduz, Principality of Liechtenstein and
Viktor Moldaschl of Dorfstr. 8, CH-9472 Grabs, Switzerland

~~is~~ (are) the actual inventor(s) of the invention and the facts upon which
The Applicant
is (~~are~~) entitled to make the application are as follows:

The applicant is a person who would if a patent were granted upon an application made by the actual inventors be entitled to have the patent assigned to it.

Declared at Schaan this 28th day of January 1991

Signed a) [signature] b) [signature] Status a) Member of the Board b) Head Clerk

Declarant's Name a) Dr. Volker Rheinberger b) Roland Mann

F. B. RICE & CO PATENT ATTORNEYS
This form is suitable for any type of Patent Application. No legalisation required.

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**PROCESS FOR PRODUCING DENTAL RESTORATIONS AND A POSITIVE WORKING MODEL FOR IMPLEMENTING THE PROCESS**

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(56) Prior Art Documents
**AU 38186/85 A61C 13/09**
**US 4207678**

(57) Claim

1. A process for producing dental crowns from plastic materials or ceramics with exactly matching coloring comprising the steps of

- producing a dental crown blank of matching shape
- producing a positive working model by placing a hardenable material into cavity of the crown which matches the shape and color of the filed remainder of a tooth, and
- coloring the dental crown blank for the dental restoration, based on combining a color chosen with a color key with the obtained positive working model.

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COMMONWEALTH OF AUSTRALIA

Patents Act 1952

COMPLETE SPECIFICATION

(ORIGINAL)

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Complete Specification for the invention entitled:

" PROCESS FOR PRODUCING DENTAL RESTORATIONS AND A POSITIVE WORKING MODEL FOR IMPLEMENTING THE PROCESS "

The following statement is a full description of this invention including the best method of performing it known to us/~~me~~:-

The invention relates to a process for producing dental restorations from plastic materials or ceramics with exactly matching coloring and to a positive working model suitable for implementing this process. The invention relates in particular to a process for producing crowns from a transparent material such as plastic materials or ceramics and to a dental stump suitable as working model for implementing this process.

It is known to produce dental restorations, especially veneer crowns, from plastic material or ceramics. These dental restorations must be colored to resemble as closely as possible the appearance of the natural teeth. To this end they are painted before polymerisation (plastic material) or firing (ceramics).

This technique is particularly applied with the poured or pressed ceramics , as described in EP-A-231 773, EP-A-30 850 and EP-A-22 665.

With the process according to EP-A 22 655, which is on the market under the name "Dicor", a castable glass ceramic is used, the cast microstructures of which refract and reflect the light in various ways resembling the light diffusion effect of the natural teeth. Heat treatment then gives the dental restoration its final strength and optical quality. To give color, the dental restorations (crowns) are painted with ceramic colors, which are then fired.

These types of dental restorations are produced as follows: the dentist files one or more teeth which are to be fitted with dental restorations (crowns). The dentist supplies the dental laboratory with an impression of the remainder of the tooth as well as details on the color of the dental restoration to be produced. The information on the color of the dental restoration is based on commercial color keys, which the dentist has at his disposal.

The dental prosthetist then produces from the impression of the remainder of the tooth a positive plaster working model corresponding to this remainder of the tooth which corresponds spatially to the mouth situation.

With the aid of this plaster model, dental restorations, such as e.g. crowns are produced using known processes according to the above-mentioned prior art. These dental restorations are usually transparent and must be painted so that their color conforms to the mouth environment.

A process for coloring fireable porcelain dental restorations is known from AT 0 047 873. This process allows dental restorations to be individually colored by the dentist himself who applies coloring solutions of various color pigments. After at least a part of the porcelain dental restoration has been coated with a film of such a coloring solution, the film is allowed to harden before a subsequent film is applied. After the predetermined number of films has been applied, the dental restoration is heated, the carrier liquid evaporates and the pigment fuses with the dental restoration and imparts to it a permanent coloring.

The greater or lesser degree of transparency of the dental restorations produced in the above-described manner has the disadvantage that it becomes very difficult for the

dental prosthetist to obtain the right coloring solely on the basis of the color determined for the dental restoration, because the ultimately visible color of the tooth is the result of a mix of the chosen color of the dental restoration and of the color of the base, i.e. of the filed remainder of the tooth. Consequently, if the positive plaster working model produced by the dental prosthetist is of a different color from the dental stump remaining in the mouth of the patient - which is usually the case - the resulting mix of colors, i.e. the color that is seen, is likewise different. This means, for example, that if a dental prosthetist has modelled a dental restoration made from plastic material or ceramics on a very light plaster model in the color given by the dentist for the same, when this dental restoration is put on or into a very dark remainder of a tooth, the resulting mix of colors does not conform. This is an unsatisfactory result and does not fulfil the cosmetic requirements.

It has now been found that this disadvantage can be successfully overcome by also determining the color of the remainder of the tooth that remains according to a color key and producing a positive working model in the color thus determined.

Consequently, the aim of the invention is to make available a process for producing dental restorations from plastic material or ceramics with exactly matching coloring, with which it is possible to achieve greater precision in coloring than before and better agreement between the prepared dental restorations and the neighbouring teeth when introduced into the mouth. A further aim of the invention is to create a faithful positive working model which is suitable for implementing this process and therefore for producing a dental restoration from plastic material or ceramics,

particularly a spatially matching positive working model that approaches the color of the filed remainder of the tooth so closely that its use enables dental restorations from plastic materials or ceramics to be simply produced with exactly matching coloring.

Accordingly, in a broad aspect the present invention provides a process for producing dental crowns from plastic materials or ceramics with exactly matching coloring by

- producing a dental crown blank of matching shape in a known manner per se
- producing a positive working model by placing a hardenable material into cavity of the crown which matches the shape and color of the filed remainder of the tooth, and
- coloring the dental crown blank for the dental restoration, based on a color chosen with a color key and using the obtained positive working model.

The present invention also provides a positive working model suitable for implementing the above process, that has the same shape as the filed remainder of the tooth and that, with the aid of a color key, has been colored in a color corresponding to the remainder of the tooth, so that by combining the color of the positive working model with the color of the dental restoration the resulting mix of colors is the same as by combining the remainder of the tooth with the dental restoration.

To implement the process of the invention according to the first alternative, firstly a dental restoration blank, eg a dental crown, is made in a known manner per se. The preparation of dental crowns or ceramics is prior art and is, for example, described in the publications named on page 1. Subsequently a hardenable material, preferably a hardenable plastic material, is placed in the cavity of the blank in order to obtain the positive working model. In addition to plastic materials,

hardenable materials which come into consideration are plaster, investment compounds, ceramics, composites, cements and also elastomeric compounds usually used for casting. They can be hot-, cold- or light-hardening or harden according to other mechanisms. A precondition of the application according to the invention is that these compounds can be colored according to the color of dental stumps. These compounds preferably have a low shrinkage level after hardening.

The dentist selects the color of the dental stump or of the remainder of the denture, eg with the aid of a known color key. If several teeth are filed, the colors of these stumps can vary, so that the dental has to select several colors. This information is passed on to the dental prosthetist who, eg selects the plastic material in the corresponding color from an existing selection of variously colored plastic materials and subsequently produces the positive working model with it. However, on the basis of this information, the tooth stump can also be colored or painted. It is further possible to color the modelling material according to the color of the remainder of the denture.

Then follows in a final stage, which is common to both variants, the coloring of the dental restoration blank by painting and characterising according to the color details from the dentist. The combination of the two colors previously established with a color key for the dental restoration (eg for the crown) and for the working model (tooth stump), makes it much easier to produce the dental restoration and a cosmetically satisfactory result quickly and surely follows.

The following example illustrates the invention:

Example

According to EP-A-231 773 and the first alternative of the process, in the first stage a blank of a dental restoration (crown) was made from ceramics: for this the dental prosthetist modelled a crown from a combustible material, preferably from wax, on a normal plaster working model cast from the dental impression. This crown of combustible material was embedded according to known techniques in a hardenable investment compound and the combustible material was removed by heating, a cavity resulting in the investment compound. Applying the measures described in EP-A-231 773 for producing a porcelain dental crown, a ceramics compound which was composed of the following was placed in this cavity:

| | |
|---|---|
| $SiO_2$ | 63 % |
| $Al_2O_3$ | 17.7 % |
| CaO | 1.5 % |
| MgO | 0.05 % |
| $Na_2O$ | 4.6 % |
| $K_2O$ | 11.2 % |
| $Ce_2O_3$ | 0.45 % |
| BaO | 0.7 % |
| $B_2O_3$ | 0.6 % |
| $TiO_2$ | 0.2 % |

The thus-obtained porcelain crown was fired in an oven at approximately 1200 °C. After firing, the muffle mould was cooled and the crown debedded. It has a certain translucence, i.e. it is transparent.

To produce the positive working model in the second stage the dental prosthetist selected the color (e.g. no. 20) from an existing selection of various-colored tooth-like light-hardening plastic materials according to the information given by the dentist. The selection contains 7 colors according to the Biochromatik color ring from

Ivoclar/Vivadent. When the color number is given, the color is clearly fixed. The light-hardening plastics material corresponds to the "Heliosit" light-hardening filling material from Vivadent with the color code 20. This is a light-hardening, micro-filled composite according to DE-PS 24 03 211. The cavity of the crown was brushed in with a commercial insulant and the light-hardening plastics material introduced into the cavity. A stump pin was pressed into the compound. This is preferably a small transparent plastics material tube. After the light-hardening plastics material has been thoroughly hardened with a commercial polymerisation lamp, the crown can be held with the aid of the stump pin.

In the final process stage, the dental prosthetist completed the crown by painting it according to the dentist's color details for the crown, using the individual dental stump. However, it can be equally well completed by veneering with ceramics or plastics material. In either case, coloring takes place quickly and reliably, because the individual positive working model in the color of the dental stump of the patient creates the right condition for speedier and optimised success. This applies not only to more transparent but also more opaque crowns, because by filling the cavity of the crown with the corresponding stump material, a color change naturally occurs even with more opaque crowns, resulting in a mixed color.

In contrast to the previous process, where the agreement of the crown or dental restoration and the remainder of the patient's denture was left to chance and the skill of the dental prosthetist, by producing the faithful positive working model of the invention, the prosthetist can simulate the mouth conditions, the positive working model acting not only as a spatial but also as a color basis for

the crown. The advantage of the invention is simply achieved by the dental prosthetist's now working according to two color details, i.e. according the color determined for the dental restoration and the color determined for the positive working model, the dentist determining both color details with a color key.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A process for producing dental crowns from plastic materials or ceramics with exactly matching coloring comprising the steps of

- producing a dental crown blank of matching shape
- producing a positive working model by placing a hardenable material into cavity of the crown which matches the shape and color of the filed remainder of a tooth, and
- coloring the dental crown blank for the dental restoration, based on combining a color chosen with a color key with the obtained positive working model.

2. Process according to claim 1, characterised in that, with the aid of a color key, the positive working model is colored in a color that exactly corresponds to the color of the remainder of the tooth.

3. Positive working model for implementing the process according to one of the preceding claims, characterised in that the positive working model matches the shape and color of the filed remainder of the tooth.

4. Positive working model according to claim 3, characterised in that, with the aid of a color key, it has been colored in a color that corresponds to the existing remainder of the tooth, so that by combining the color of the working model with the color of the dental restoration the resulting mixed color is the same as by combining the remainder of the tooth with the dental restoration.

5. A process for producing dental crowns substantially as hereinbefore described with reference to the accompanying example.

6. A positive working model for implementing the process of claims 1, 2 or 5 substantially as hereinbefore described with reference to the accompanying drawings.

DATED this 16 day of November 1992

IVOCLAR AG
Patent Attorneys for the
Applicant:

F.B. RICE & CO.