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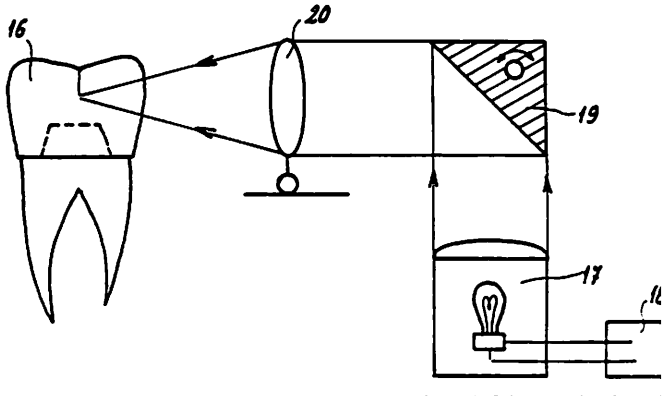
(54) Title: METHOD FOR DYEING MEDICAL PROSTHESES AND DEVICE FOR IMPLEMENTING SAME

(54) Titre: PROCEDE DE COLORATION DE PROTHESES MEDICALES ET DISPOSITIF POUR SA MISE EN ŒUVRE

(57) Abstract

The method involves providing, in the mass of the prosthesis (16) or on the surface thereof, at least one kind of photo- or thermochromic pigment, and projecting an appropriate focused or unfocused beam onto the prosthesis to make the pigments react. The device for implementing the method includes a computing device which knows the general shape of the prosthesis to be dyed, the nature of the pigments and their reactivity, the beam sources, the mobility of the focusing system, and a device (7) for analyzing the colour of said prosthesis. The computing device, on the basis of the desired colour tone data and as the dyeing operation progresses, controls the selection (5) of beam emissions from the different sources (4), focusing (36) and the fixing (15) of the correct colour tone once it has been achieved. The method and device can be used for dyeing artificial dentures.



(57) Abrégé

Ce procédé consiste à inclure dans la masse de la prothèse (16) ou à la surface de celle-ci au moins un type de pigments photo- ou thermochromiques, puis à projeter sur la prothèse un faisceau focalisé ou non, de nature adaptée à celle des pigments de façon à faire réagir ceux-ci. Le dispositif pour sa mise en œuvre comprend un calculateur connaissant la forme générale de la prothèse à colorer, la nature des pigments et la réactivité de ceux-ci, les sources d'émission de faisceaux, les latitudes de mouvement du système de focalisation, et un dispositif (7) d'analyse de la couleur de la prothèse, le calculateur commandant, à partir de l'information de la teinte à obtenir et en suivant l'opération de coloration, la sélection (5) d'émission des faisceaux des différentes sources (4), le contrôle de la focalisation (36), et la fixation (15) de la teinte lorsque la nuance souhaitée est atteinte. Application à la coloration de prothèses dentaires.

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PATENT APPLICATION
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: Federal Republic of Germany, Austria, Belgium, Denmark, Spain, France, Great Britain, Italy, Luxembourg, Holland, Sweden, Switzerland and Liechtenstein

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9, 1990

for the coloring of medical prosthesis and for its implementation

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The present invention relates to a method for dyeing medical prostheses and a device for its implementation.

Medical prostheses, particularly fixed or removable dental prostheses, regardless of how they were made, are frequently dyed or must be dyed so that they match their environment.

For example, in the case of a dental crown, it is known to use resins containing pigments of varying darknesses, which are selected on the basis of the color of the neighboring tooth using a reference color range chart.

A ceramic powder or resin corresponds to each shade of color tone corresponds and the resulting definitive color is produced by the appropriate selection of the dyes.

The use of a colorless vitreous ceramic for the surface makeup or transparency makeup is also known. The aim, in a manner of speaking, is to paint the surface of the tooth.

To obtain a certain depth of color, it is also known that the ceramic worker uses, in addition to the coloring powders, successive transparent layers of a [certain] thickness placed between the dye and the surface of the tooth. Thus, to make a ceramic-metallic prosthesis, the practitioner must successively position one layer of metal, one opaque layer covering the metal layer, one layer of dye, one layer of transparent material, and a superficial varnish layer.

In this way, it is possible to have seven successive layers in some prostheses.

The purpose of the present invention is to remedy these drawbacks by supplying a method for dyeing, which is simple in design, rapid to implement, and which produces excellent results,

allowing to impart to a prosthesis, and particularly a dental prosthesis, a color that is in harmony with its environment.

For this purpose, the method of the invention includes, in the bulk of the prosthesis or on the surface of the prosthesis, at least one photo- or thermochromic pigment, following by the projection of a focused or unfocused beam onto the prosthesis, of a type such that it causes a reaction of the pigments.

The projected beam can be a light beam, a heat beam, [illegible] of another type of radiation such as X-rays.

This technique allows the preparation of a single material for prostheses or mechanical reconstitution, which integrates the dyeing system; [it permits] the creation of the coloring effect a posteriori, that is, after the manufacture of the piece.

This technique allows one to make the color appear natural in all areas of the material by acting on the focusing or unfocusing of the beam, which avoids the construction of successive layers. This natural appearance of the coloring is the result of, among other factors, the progression of the defocusing of the beam that naturally occurs at the edge of the opening, avoiding abrupt ruptures.

According to a first embodiment, each type of pigment has an irreversible coloring.

According to another embodiment, each type of pigment has a reversible coloring that allows one, when the hue obtained after the emission of one or several beams is not satisfactory, to return to the initial state by the emission of a new beam.

According to one embodiment, this method consists of conducting a fixation operation of the coloring of the pigments. This fixation of the coloring of the pigments can be obtained by

directing a beam onto the prosthesis, by an electrical method such as ionophoresis or electrophoresis, or by chemical reaction after the deposition of a fixation substance on the surface of the prostheses.

This fixation can take place after the release of radicals or by activating molecules capable of becoming attached to the pigments by preventing the latter from returning to their initial state, which ensures maintenance of the initial coloring.

The beam projected onto the prosthesis to cause the pigments to react can be a beam of noncoherent light, with the beam passing through filters, for example, mounted on a body tube; the filters have colors corresponding to the absorption bands of each pigment.

It is also possible to project, onto the prosthesis, at least one laser beam of the filtered laser type, using a band that is particularly active for each pigment, or a solid laser beam with selection of the active band for each pigment to be reacted.

It is possible to project onto the prosthesis, simultaneously or successively, several beams each of which is intended to react [activate] one type of pigment. As indicated above, it is possible, during the course of the projection of a beam, to vary the focusing of the beam to obtain the desired aesthetic effect.

For example, an overall brown hue will be obtained by a beam that is greatly absorbed by photochromic pigments, for example, silver halide. By varying the latency time before return to the original condition, it is possible to control the color obtained. Other pigments that react to produce blue colors permit the

production of a transparency effect that is particularly useful in dental prostheses, particularly in the zones corresponding to the edges of the teeth.

It should be noted that it is possible, using several types of red, green, and blue pigments simultaneously, to obtain an infinity of shades by reacting these pigments to varying degrees.

A device for the implementation of this method comprises at least one beam-emission system and one optical focusing system with adjustable positions.

If several emission sources are used, it is advantageous to provide a movable optical system that successively ensures the deviation [deflection] of the bean omitted by each source towards the focusing system.

According to one possibility, the emission source is mounted at the site of the tool-attachment pin of a machine tool with numerical control, with the prosthesis being attached to a machining support. It is also possible to use the tool-attachment pin of the machine tool by attaching to it an emission head that is connected by optical fibers to the emission source.

According to an advantageous embodiment, this device comprises a computer that knows the general shape of the prosthesis to be colored, the nature of the pigments and their reactivities, the sources of beam emission, the latitudes of movement of the focusing system, and a device for the analysis of the color of the prosthesis, with the computer controlling, on the basis of information on the hue to be produced and by monitoring the dyeing operation, the selection of the different sources for beam emission, the control of focusing, and the fixation of the hue when the desired shade is attained.

In any case, the invention will be well understood on the basis of the following descriptions made with reference to the diagrammatic drawing in the appendix which represents, as nonlimiting examples, several variants of a device for the embodiment of this method:

Figure 1 is a view of a block diagram representing a device;

Figure 2 is a view of the first optical system;

Figures 3 and 4 are two views representing two systems for the emission of a light beam;

Figure 5 is a diagrammatic view representing a defocusing operation during the course of emission;

Figure 6 is a view of an assembly of an emission source on a three-axis robot;

Figures 7 and 8 are two views describing the assembly of an emission head on the tool attachment of a machining tool;

Figure 9 is a view of one example of a pigment reaction.

Figure 1 represents a device for dyeing the bulk of prosthesis (2) or on the surface of which there are photosensitive pigments (3). The emission of light is conducted using several sources (4) specific for each pigment to be colored, with the interposition of a system for source selection (5) and a focusing system (6).

This device comprises a system (7) for the analysis of the color of the tooth adjacent to the prosthesis, and in the case of a dental prosthesis, the color of the adjacent teeth constituting the reference color to be produced.

This device for analysis is connected to a blockage (8, 9) for the calculation of colors that provides information to a system (10) of localization of the colors that control, on the

one hand, generator (12) equipped with sources (4), and on the other hand, block (13) for the control of the focusing system (6).

This device also comprises a control system (14) that acts on block (10) for the localization of the colors to ensure the monitoring of the emission of the different light beams, and that acts on block (15) that selects a beam ensuring the fixation of the pigments in the condition in which they are when the color obtained corresponds to the reference color.

Figure 2 represents a dental prosthesis (16) that contains colored pigments, on which an insulation is made from a light source (17) equipped with a power variator (18), with the beam emitted by the source being reflected by a prism (19) on a focusing system (20) that can be moved in the direction of the beam.

As shown in Figure 5, the displacement of the focusing system (20) allows a defocusing that permits various shades of the coloring of the pigments.

In the embodiment shown in Figure 3, source (18a) is a source of noncoherent light that emits a beam able to pass through filter (22) that, mounted in a barrel (23) placed between the source and the focusing system, has a color corresponding to the absorption bands of each pigment.

In the embodiment shown in Figure 4, several sources (18b), (18c), and (18d) emit beams that are transmitted through the intermediary of a prism (24) driven in a rotational motion by a motor (25) onto focusing system (20).

In the embodiment shown in Figure 6, prosthesis (16) is mounted at one extremity of fixation arm (26), with the beam

consisting of a laser source (27) mounted on a three-axle robot driven by motors (28), (29), and (30) in three perpendicular directions.

Figure 7 shows a magazine (32) of tools (33) used by a machine tool with numerical command for the machining of a prosthesis. In one recess of disk (32), a head (34) for beam emission is placed, connected by optical fiber (35) to a source (36).

This head (34) can, like the tools (33), be attached to the tool-attachment pin (37) of the machining tool with numerical control.

Figure 9 represents one coloring process as an example. The uncolored pigment in state A changes color as a result of the action of exposure to radiation because its molecular structure is modified to form state B.

As a result of the action of another source of radiation, and by association with a stabilizing molecule C, the pigment can be brought into state D where it is both colored and stable.

As can be concluded from the above, the invention provides a great improvement to the existing technique by supplying a method and a device for coloring medical prostheses, particularly dental prostheses, which are simple in design, rapidly implemented and which permit the production of the desired shades of color.

Naturally, the invention is not limited to the single embodiment of this method, or only to embodiments of this device, described above as examples; in contrast, it comprises all the variants.

Thus, in particular, the color of the pigments could be modified as a result of the action of heat radiation, without leaving the scope of the invention.

Claims

1. Method for the coloring of medical prostheses, characterized in that it consists of including, in the bulk of the prosthesis (16) or at the surface of the latter, at least one type of photochromic or thermochromic pigment, followed by the projection of a focused or unfocused beam onto the prosthesis, which beam has such an effect the pigments that it causes them to react.

2. Method according to Claim 1, characterized by the fact that each type of pigment used has irreversible coloring.

3. Method according to Claim 2, characterized in that each type of pigment used has reversible coloring.

4. Method according to any one of Claims 1 to 3, characterized in that it consists of conducting a fixation operation of the coloring pigments.

5. Method according to Claim 4, characterized by the fact that fixation of the coloring of the pigments is conducted by directing a beam onto the prosthesis.

6. Method according to Claim 4, characterized by the fact that the fixation of the coloring of the pigments is conducted by an electrical method such as ionophoresis or electrophoresis.

7. Method according to Claim 4, characterized in that the fixation of the coloring of the pigments is conducted by a

chemical method, by the deposition of a fixation substance on the surface of the prosthesis.

8. Method according to any one of Claims 1 to 7, characterized in that it consists of conducting a modification of the state of the pigments by the projection of at least one light beam onto the prosthesis.

9. Method according to Claim 8, characterized in that it consists of projecting, onto the prosthesis, at least one laser beam of the filtered laser type, using a particular band for each pigment considered, or a solid laser beam of which one selects an active band for each pigment to be reacted.

10. Method according to Claim 8, characterized by the fact that it consists of projecting a beam of noncoherent light, and in passing this beam through color filters corresponding to the absorption bands for each pigment.

11. Method according to any one of Claims 1 through 10, characterized in that it consists of projecting onto the prosthesis, simultaneously or successively, several beams each of which is intended to cause a certain pigment to react.

12. Method according to any one of Claims 1 to 11, characterized by the fact that it consists of conducting, during the course of the projection of the beam onto the prosthesis, a defocusing of the beam.

13. Device for the implementation of the method according to any one of Claims 1 to 12, characterized in that it comprises at least one source of emission (4,17,18), of a beam and an optical focusing system (20) with adjustable positions.

14. Device according to Claim 13, characterized by the fact that it comprises several sources of emission (18b,18c,18d) and a

movable optical system such as a prism (24) to conduct the deviation [deflection] of the beam emitted by each source towards the focusing system (20).

15. Device according to Claim 14, characterized in that it comprises a source of noncoherent light (18a) and a barrel (23) fitted with several filters (22) placed between the source and the focusing system (20).

16. Device according to Claim 13, characterized by the fact that the source of emission (27) is mounted at the site of the tool-attachment pin of a machining tool with numerical control, while the prosthesis (16) is attached to a machining support (26).

17. Device according to Claim 13, characterized by the fact that the source of emission (36) is fixed and is selected by optical fiber (35) to emission head (34) intended to be stored on tool magazine (32) of a machining tool, and to be attached to the pin (37) of the machining tool prior to the pigment-activation operation.

18. Device according to Claim 13, characterized in that it comprises a computing device that knows the general shape of the prosthesis to be colored, the nature of the pigments and the reactivity of the latter, the sources of emission of the beams, and the latitudes of the movement of the focusing system, and a device (7) for the analysis of the color of the prosthesis, with the computing device controlling, on the basis of the hue to be produced and according to the coloring operation, the selection (5) of the emission of beams from different sources (4), the control of focusing (36), and the fixation (15) of the hue when the desired shade is attained.

FIG_1

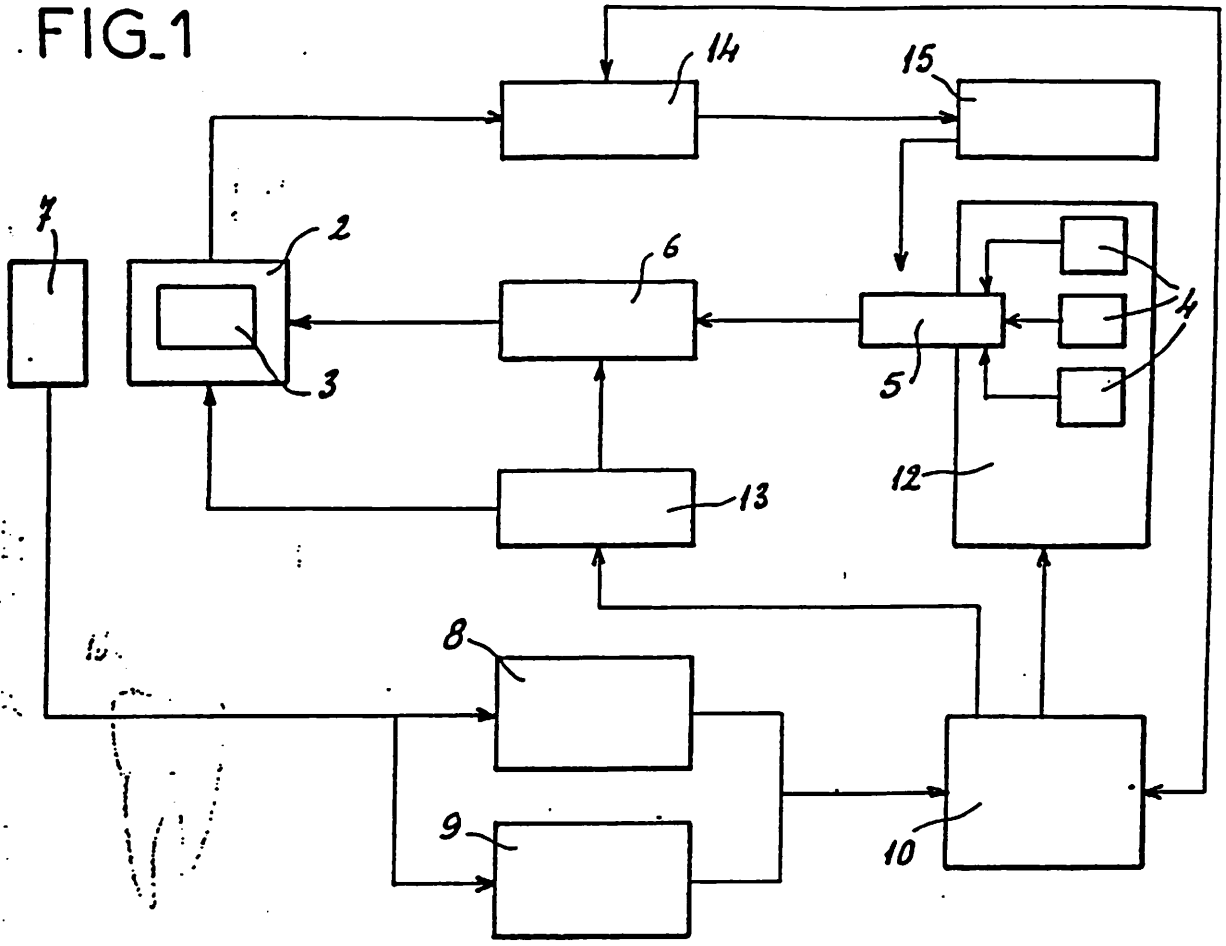


FIG_2

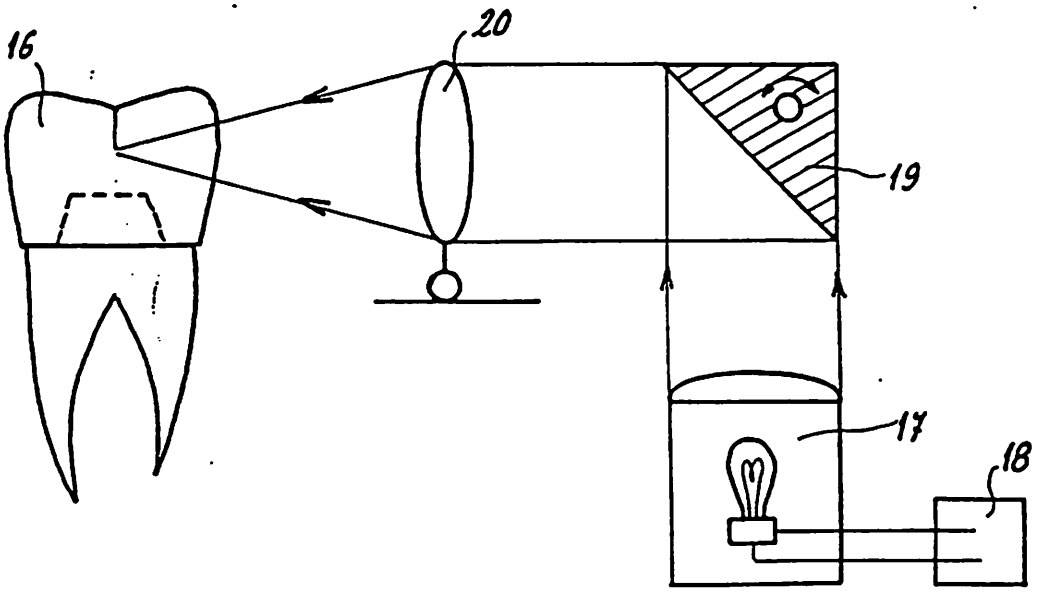


FIG_3

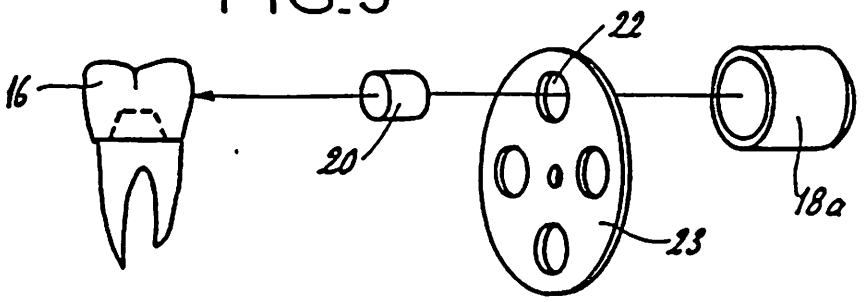


FIG_4

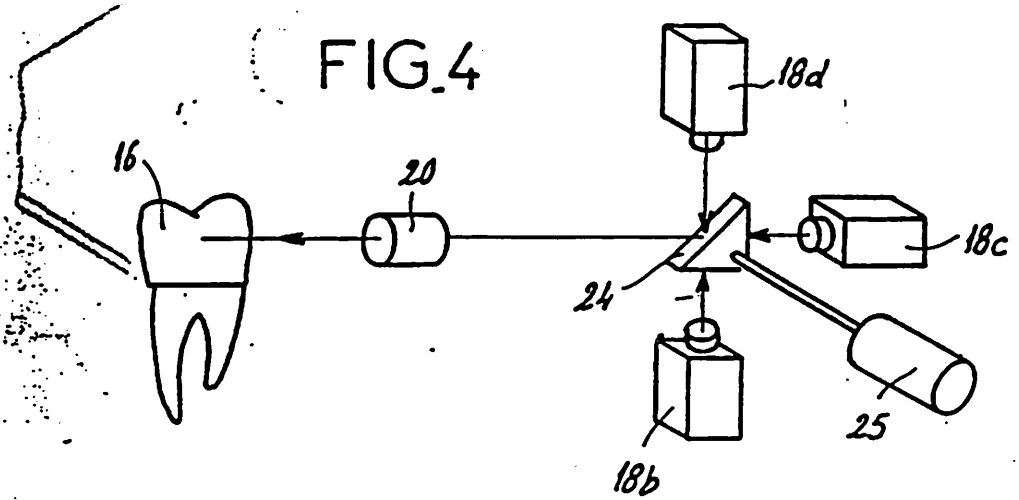


FIG_5

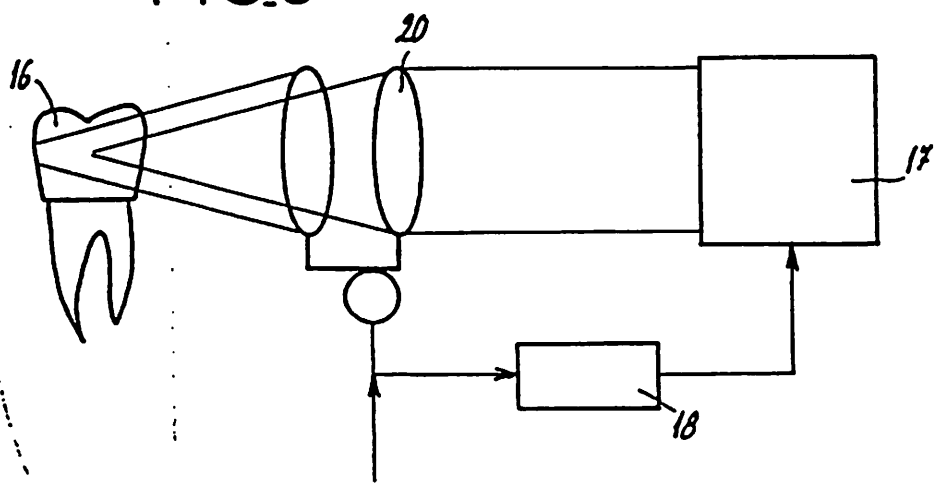


FIG_6

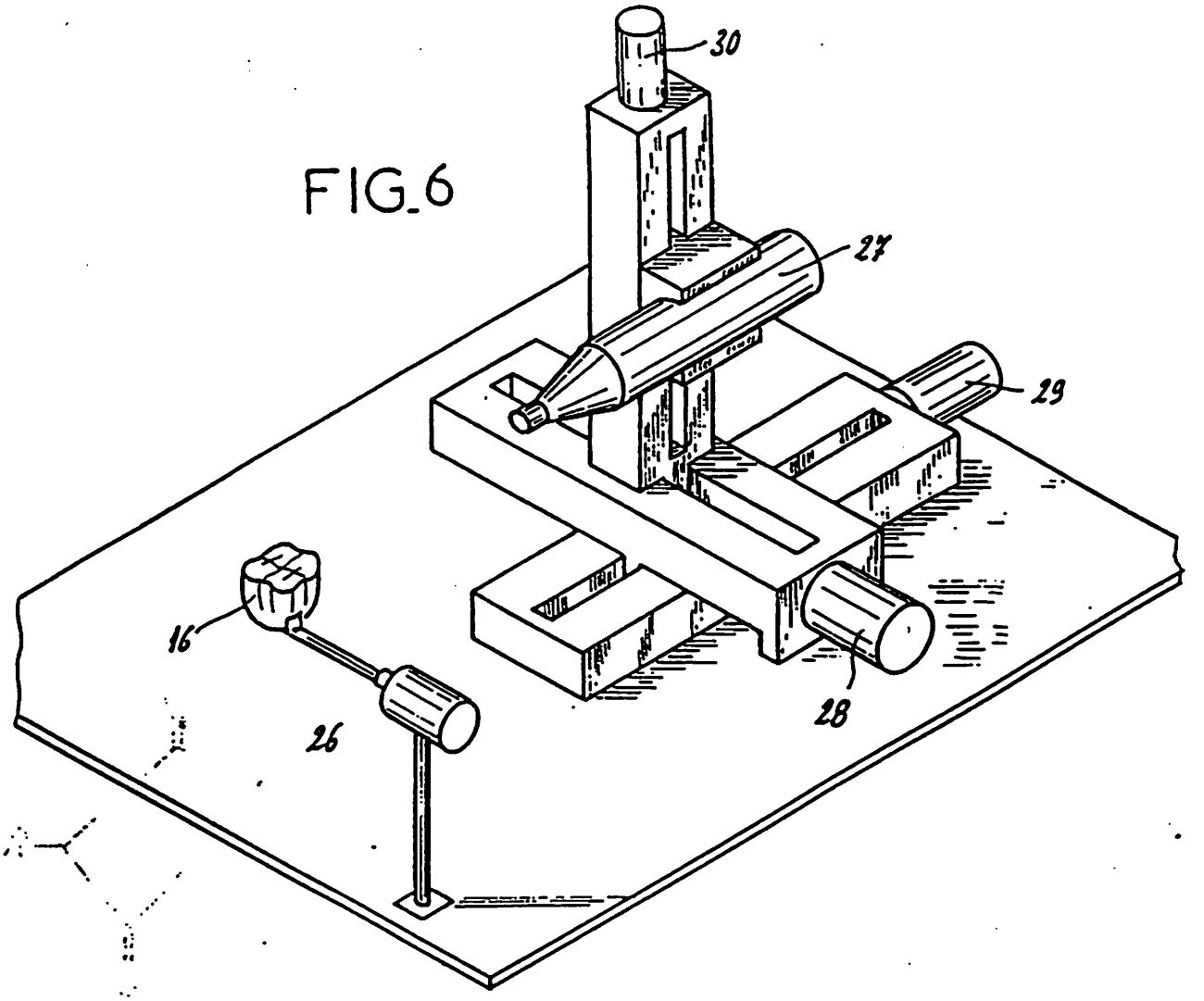


FIG_7

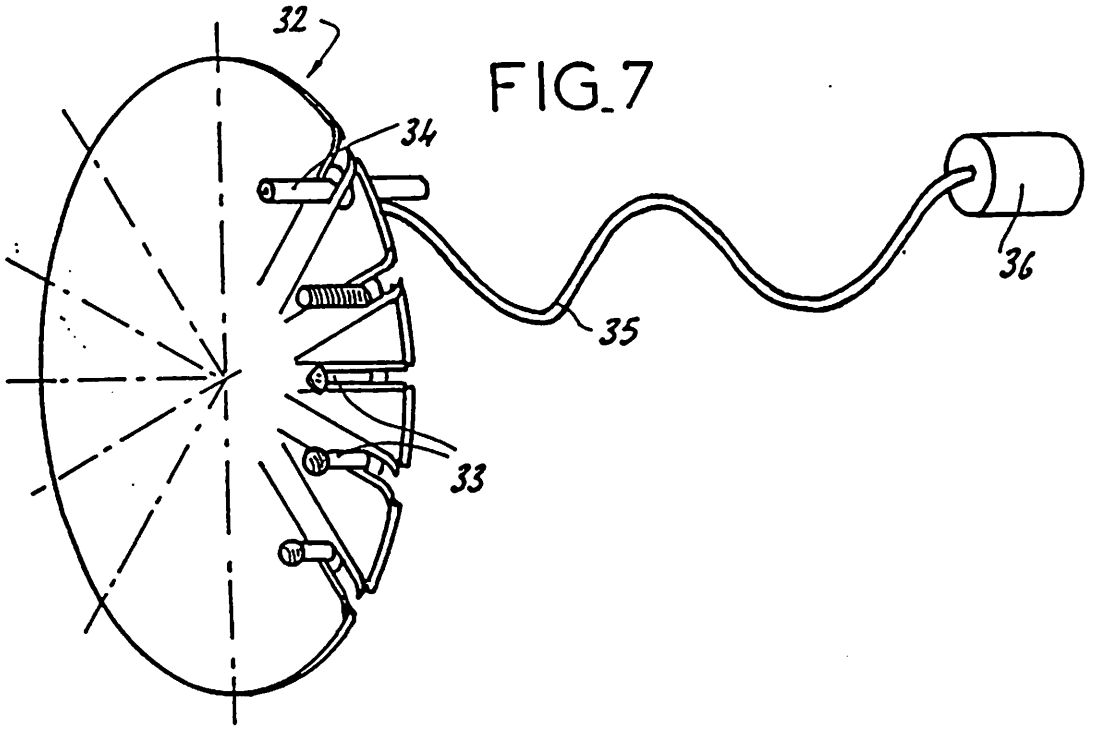


FIG.8

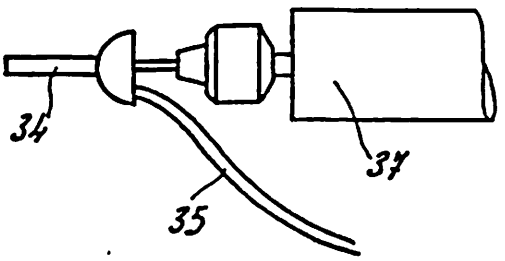
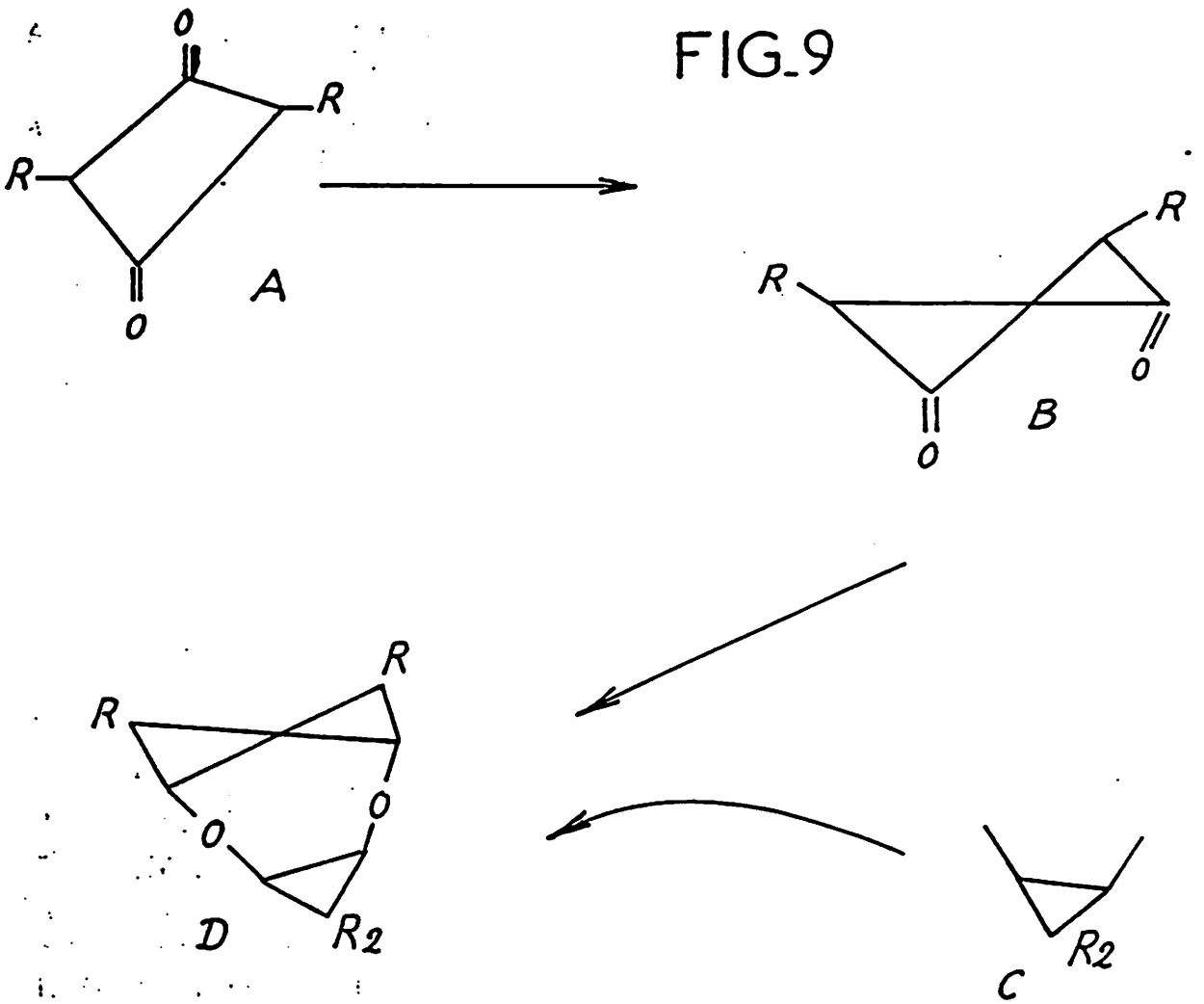


FIG.9



International Application No PCT/FR 90/00489

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[5] A61K 6/00, A61C 19/10

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[5]	A61K, A61L, A61C

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
E	FR, A, 2642959 (F. DURET) 17 August 1990 see the whole document	1-18
A	DE, A, 3731492 (ALLDENT AG) 28 January 1988	
A	GB, A, 2000174 (RIEDEL-DEHAEN AG) 4 January 1979	

- Special categories of cited documents: [14]
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- "&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
12 February 1991 (12.02.91)	26 February 1991 (26.02.91)
International Searching Authority	**Signature of Authorized Officer**
European Patent Office	

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. FR 9000489 SA 38499

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 20/02/91
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR-A- 2642959	17-08-90	None	
DE-A- 3731492	28-01-88	None	
GB-A- 2000174	04-01-79	DE-A,B,C 2728266	11-01-79
		CH-A- 636120	13-05-83
		JP-A,B,C54010287	25-01-79
		US-A- 4167417	11-09-79