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[54] **DENTAL IMPRESSION WAFER**
7 Claims, No Drawings

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[56] **References Cited**

UNITED STATES PATENTS

2,633,637 4/1953 Lucia 32/19
3,046,658 7/1962 Joffe 32/19

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ABSTRACT: A wafer consisting of a plastic carrier foil thinner than 0.020 mm. and of high mechanical strength and a coating of impression wax on one or both faces of the foil can be compressed between teeth of a dentist's patient under high bite pressure without disturbing the normal bite of any tooth in the patient's mouth because of the elastic compressibility of the periodontal membranes. The impressions obtained in the wafer thus are undistorted.

DENTAL IMPRESSION WAFER

This invention relates to bite registration in the human mouth and particularly to a dental impression wafer suitable for producing visible indicia of the relative position and the shapes of the tooth crowns.

In its more specific aspects, this invention is concerned with an improvement in the high spot marker disclosed in the Lucia U.S. Pat. No. 2,633,673, issued on Apr. 7, 1963. It was found by the patentee that a laminate of two wax layers separated by a sheet material coated with a marking substance provides a better indication of high spots or cuspal interferences than carbon paper.

It has now been found that any material placed between the opposite teeth of the upper and lower jaws and having a thickness of at least 0.020 mm. interferes with the normal interengagement of the teeth, and that indications of spatial relationships between the opposite teeth obtained by a bite test while any opposite teeth in the mouth are separated by an inserted material at least 0.020 mm. thick are distorted.

The distortion is readily demonstrated by means of a simple test using strong plastic foil 0.0005 inches (0.0127 mm.) thick. When one such foil is placed between the molars on one side of a person's mouth, two layers of the same foil are placed between the molars on the other side, and the patient bits on the plastic, the single foil cannot be pulled from the mouth. When one layer of foil is interposed between the molars on one side and three layers on the other side, the single foil layer cannot be retained against a pulling force by the tested person's bite, hard as he may try. More elaborate tests show that the limit to which the teeth on one side may be spread farther apart than on the other side without preventing proper bit registration is at or below 0.020 mm. for a normal, healthy adult.

The cause for the phenomenon described in the preceding paragraph has been found in the resilient compressibility of the periodontal membranes which separate the roots of the teeth from the bones of the jaws. The membranes have normally a thickness of about 0.030 to 0.035 mm. and can be reduced in thickness by slightly less than 0.010 mm. by the forces available in biting so that a separation of the upper and lower teeth by less than 0.020 mm. may be compensated by compression of the periodontal membranes, but not a greater separation.

Based on these findings, I have prepared dental wafers which permit premature engagement of the teeth and bit deflection to be registered with great precision so as to be readily recognized and correctly evaluated by a dentist or dental technician.

At the core of this invention is the use of a carrier of strong but pliable sheet material having a thickness of less than 0.020 mm. and of a coating of plastically deformable impression material on at least one of the two faces of the carrier. The mechanical strength of the sheet material must be much greater than that of the impression material, and the latter must be shape retaining at the approximate temperature of the mouth cavity or approximately 37° C.

If a wafer meeting these requirements is placed between opposite teeth and a bit impression is taken, the impression material is plastically deformed without affecting the ultimate spatial relationship of the teeth. It will be appreciated that the layer of impression material should be reasonably thin, thicker than the carrier but thinner than 0.5 inch. Normally, all objects of an occlusal registration test are achieved with a layer of impression material having a thickness of approximately 3 mm. on each of the two faces of the carrier sheet, but the thickness of the impression material may be varied within wide limits to suit specific conditions.

Metallic foils of aluminum and gold meeting the above thickness requirements are mechanically much stronger than layers of conventional bite waxes applied thereto and may be employed as carrier sheets. However, the metal may set up electrolytic cells with other metal in the patient's mouth, and many patients are sensitive to the minute electric currents

produced thereby. It is therefore preferred to employ nonmetallic and nonconductive carrier sheets. All plastics commercially available to me in the forms of foils having a nominal thickness of not more than 0.00075 inches or 0.015 mm. have been found effective in the wafers of this invention. The precise chemical nature of the carrier is immaterial.

Good wafers have thus been prepared from polyvinyl fluoride films having a tensile strength of less than 10,000 p.s.i. (Tedlar), from polyester films which essentially consist of polycondensates of ethyleneglycol and terephthalic acid having tensile strengths as high as 40,000 p.s.i. (Mylar Type T), and from polyimide films (Kapton) which are intermediate in tensile properties between the polyvinyl fluoride and polyester films The wide range of elongation values represented by these film materials does not appear to have significant effects on the results achieved.

The impression materials preferred as coatings on the carrier sheet are wax compositions commonly referred to as "bite waxes." A mixture of about equal parts of bees wax, soft paraffin, and carnauba wax may be employed successfully, but sharper impressions have been obtained with most commercial bite waxes whose compositions are not revealed by their manufacturers, and which are believed to contain resins in addition to various waxes.

All wax-based impression materials adhere adequately to the aforementioned film materials, but not so strongly that the wax should not be displaced by the engaged teeth without puncturing the carrier sheet because of the resiliency of the periodontal membranes.

When a wafer of the invention is introduced between the teeth of a patient, and the patient thereafter closes his mouth and engages his teeth, and opaque wax is displaced completely from areas of premature tooth engagement, and such areas are readily recognized by their previousness to transmitted light if a clear film was employed as a carrier sheet.

Very good indications of premature tooth engagement have been obtained with wafers whose carrier sheet is provided with a reflecting coating on either face, the areas of premature tooth engagement thereby being made clearly visible in incident light. Plastic foils of the required thinness and provided with a reflecting layer of aluminum are staple articles of commerce.

Deflective contact between opposite teeth is very easily detected by the face that the layer of impression material is scraped from the carrier sheet over a substantial area and piled up in a ridge, the transparent or reflecting carrier sheet being visible in the scraped area.

Bite waxes are the preferred coating materials at this time, and are normally applied to both faces of the carrier sheet. The wafer so obtained is capable of being stored without unusual precautions for a practically unlimited time and is thereafter instantaneously ready for use. If such extended shelf life and immediate use are not required, and inherent properties of waxes are undesirable under specific conditions of operation, other impression materials may be employed. I have used self-setting acrylic dental compositions as coating materials on polyester film with good results, but the advantages achieved are not normally worth the effort, minor though it may be, of making a wafer ready for use prior to each application.

The polyester resin material mentioned above is not fully resistant to alkalis, and actually dissolves in very strong aqueous ammonia within a few minutes. This fact can be used to advantage in work on dentures mounted in an articulator. A wax-coated polyester resin carrier is inserted between the teeth of the denture and an impression of high spots in the wax layers is obtained, exposing the carrier. When a drop of strong ammonia is placed into the cup formed by the depression in the wax, the plastic is perforated where it is not masked by the wax. When the perforated sheet is placed over either half of the denture and dusted with a dark pigment, a pigment spot is found at the location of each perforation when the wafer is subsequently removed. The spot is more clearly defined and

more precisely located than a spot obtained by means of carbon paper and like material.

Obviously, similar results can be achieved by piercing the clearly delineated transparent or reflective areas surrounded by the opaque wax or other impression material by means of a needle instead of etching the plastic until perforated. The mechanical piercing technique is not limited to any specific carrier material.

It has additionally been found that the plastic carrier sheet is deformed under the stresses applied during the bite test, and is retained in its deformed shape by the relatively thick wax coating. When the plastic sheet material is birefringent under stress, a stress pattern is readily observed in the portion of the carrier sheet denuded of wax when the wafer is observed between two sheets of polarizing material. Minute details of the stress distribution in the contact area are readily visualized and provide further guidance to the dentist or dental technician. Quantitative conclusions as to applied pressure and pressure distribution are possible after some experience with a specific type of carrier sheet.

The wafers of the invention may be cut by the user from sheets of any convenient size prior to use, or they may be supplied in precut pieces approximately 2 cm. × 5 cm.

What is claimed is:

1. A dental impression wafer essentially consisting of

a. a carrier of pliable sheet material having a thickness of less than 0.020 mm., and

b. a coating of a plastically deformable impression material on at least one of the two faces of said carrier.

1. the mechanical strength of said sheet material being substantially greater than the strength of said coating on said one face,
2. said impression material being shape retaining at a temperature of 37° C., and
3. the thickness of the coating on said one face being greater than the thickness of said carrier.

2. A wafer as set forth in claim 1, wherein said sheet material essentially consists of synthetic resin composition.

3. A wafer as set forth in claim 2, wherein said resin composition is a polycondensate of ethyleneglycol and terephthalic acid.

4. A wafer as set forth in claim 1, wherein said sheet material is birefringent when stressed.

5. A wafer as set forth in claim 1, further comprising a reflective coating on said sheet material, said impression material being substantially impervious to light.

6. A wafer as set forth in claim 1, wherein a coating of said impression material is on both faces of said sheet material, the thickness of each coating being greater than the thickness of said carrier.

7. A wafer as set forth in claim 1, wherein said material is a bite wax.