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C. H. PRANGE ET AL

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SWAGED DENTURE AND METHOD OF MAKING THE SAME

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Fig. 1



Fig. 2

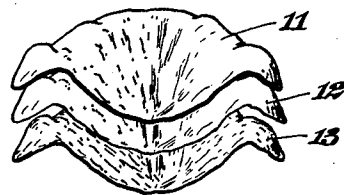


Fig. 3

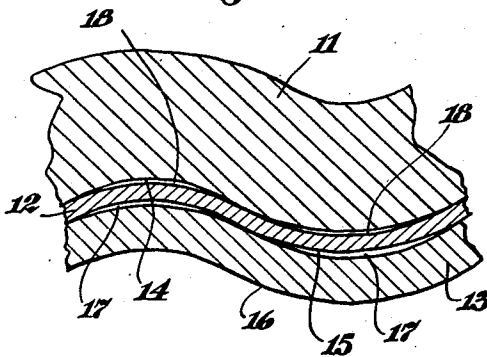


Fig. 4

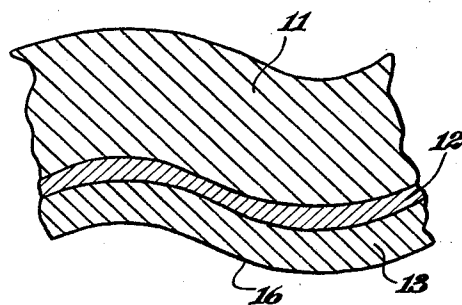


Fig. 5

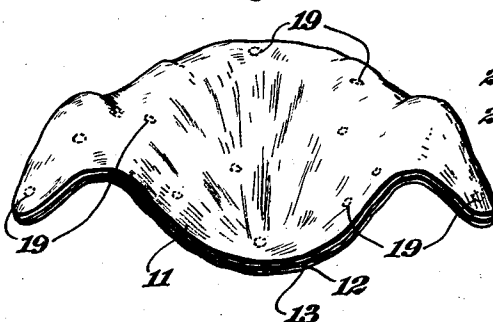
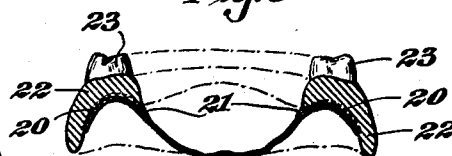


Fig. 6



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SWAGED DENTURE AND METHOD OF MAKING THE SAME

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9 Claims. (Cl. 32—2)

Our present invention relates generally to dentures, and has particular reference to an improved denture base of the swaged type and to a method of making the same.

While we have herein illustrated and shall hereinafter describe the present invention in connection with a denture constituting what is known in the profession as a "full upper", nevertheless it will be understood that the invention is not restricted to this specific type of device.

Among the vital requirements that must be complied with in making a denture of good quality are the requirements that it embody sufficient rigidity and staunchness to retain its general contour over long periods of use, and that the inner surface (i. e., the surface that bears against the tissues of the mouth) conform with as much accuracy as possible to the unique irregularities and convolutions of the mouth for which it is intended. In the case of ordinary swaged denture bases (as distinguished from those which are cast), the simultaneous compliance with these two requirements is beset with difficulty. In a swaging operation, the accurate conformity with the irregularities of a dental pattern results from the ductility of the material that is pressed against the pattern. In the case of sheet metal, the thinner the sheet the greater its ability to partake of the detailed convolutions of the pattern. A sheet of foil-like thinness would be ideal, for example, from this standpoint. However, the thinner the sheet the weaker the resultant denture.

Accordingly, the manufacture of swaged dentures has heretofore involved a sort of compromise between the employment of a sheet of sufficient thinness to conform with the details of the pattern, yet of sufficient thickness to impart adequate rigidity to the resultant article.

In accordance with our present invention, this dilemma is obviated, and we are enabled to produce a swaged denture base which is not only of sufficient staunchness and rigidity, but which at the same time embodies an inner surface which bears an unusually accurate and detailed imprint of the irregularities and convolutions of the pattern in question.

One of the features of our invention lies in forming the denture base of two plies of material, one of which is relatively weak but of great deformability, while the other of which is less deformable but of greater strength. These two plies are individually swaged into conformity with the unique irregularities of a pattern, and they are thereupon bonded together in nested

relationship to form a completely integrated unit with the weak ply on the inside. The weak but more deformable ply imparts to the resultant denture base an inner surface which accurately reflects the configurations of the mouth surfaces for which the denture is intended; while the stronger ply imparts to the resultant denture the requisite rigidity and strength.

One of the features of the invention leading to a successful accomplishment of the present objectives resides in the manner in which the two plies are bonded together into inseparable integral relationship. In accordance with our present mode of procedure, a third ply of sheet material is swaged into conformity with the pattern, and consists of an extremely thin sheet of fusible material which is sandwiched between the first-mentioned plies and which ultimately serves as a bonding agent or spacer. The material used for this bonding purpose must embody ductility; it must have a relatively low fusibility; it must have an ability readily to "wet" the material contacting its opposite surfaces; it must be unreactive to, and unaffected by, mouth fluids; and it must not be objectionable in taste or characteristics. Preferably, we employ a noble metal such as silver or gold, or alloys of the two.

Where silver is employed as the intermediate spacer or ply, it is a further feature of our invention to condition the same so as to increase its "wettability" with respect to the denture base material with which it is employed. We have found that by electroplating a silver foil with an extremely thin layer of a material of the group which includes copper, tin, platinum, and gold, the "wetting" qualities of the silver, when fused, are greatly enhanced.

Briefly, the procedural steps entering into our present invention are (1) individually swaging into conformity with the pattern the three plies of material hereinbefore mentioned, (2) nesting these plies together to form a denture base assembly, (3) reswaging the assembly to squeeze the intermediate bonding ply into more intimate contact with the surfaces contacting with it on opposite sides, (4) spot-welding the plies together to bond them preliminarily, and (5) finally fusing the intermediate layer so as to bond the elements of the assembly into a completely integrated unit.

We achieve the foregoing objects, and such other objects as may hereinafter appear or be pointed out, in the manner illustratively exemplified in the accompanying drawing, wherein—

Figure 1 is a perspective view of an illustrative dental pattern;

Figure 2 is a perspective view of the three plies of material after they have been individually swaged;

Figure 3 is a greatly enlarged and exaggerated cross-sectional view through the assembly after the plies have been initially nested;

Figure 4 is a view similar to Figure 3, showing the relationship of the parts after the assembly has been subjected to reswaging upon the die or pattern of Figure 1;

Figure 5 is a perspective view of the assembly prior to the fusing step; and

Figure 6 is a cross-sectional view through a resultant complete denture.

The die 10 shown in Figure 1 is made of metal and is an exact duplicate of the plaster model which is originally prepared by the dentist from impressions taken within the patient's mouth. It will be understood that the die 10 is used with a companion die, also of metal, the set being preferably but not necessarily produced substantially in the manner described in the Erdle Patent Number 1,834,123. The die 10 and its companion (not shown) are adapted to be inserted into suitable supports, so that the pair may be interposed into a hydraulic press or the like. When the dies are pressed toward each other, any interposed sheet or material is swaged into conformity. It is the upper surface of the die 10 which is of primary importance, and the completed denture should have an inner surface which bears an imprint, as accurate and detailed as possible, at the irregularities of this upper surface.

In accordance with our invention, three plies 11, 12, and 13 are successively and individually swaged into conformity with the die 10. Each of the plies 11 and 13 is preferably of sheet metal of suitable character. For example, the metal may be an alloy of chromium, nickel, and steel, or an alloy of chromium and nickel, or of any other suitable denture base material.

The intermediate ply 12 is a metallic foil which may be composed of gold, silver, or, in general, any suitable fusible metal or alloy of suitable ductility. Silver has been found to be preferable.

The ply 11 ultimately serves as the lingual side of the denture base, and the exposed surface of the ply 13 is the one which ultimately bears against the tissues of the mouth. The ply 13 is, therefore, referred to herein and in the appended claims as the "inner" ply, and by this term it will be understood that it is intended to refer to the surface that would be known as the "palatal" surface in the case of an upper denture, or the "ridge" or "alveolar" surface in the case of a lower denture.

In accordance with the present invention, the ply 11 has a thickness of the order of .010-.012 inch; while the ply 13 is of foil-like thinness, of the order of approximately .003 inch. The foil 12 has a thickness no greater than about .001 inch.

When the plies are individually swaged against the die 10, it will be found that the ply 13, because of its relative thinness, and hence because of its corresponding increased ductility, partakes with remarkable accuracy of the unique irregularities of the surface of the die 10. A corresponding imprint, but of lesser accuracy in details, is provided on the ply 11. Needless to say, the ply 12 conforms with little difficulty to every minute irregularity.

Where the intermediate ply 12 is of silver foil,

the next step in the process is to subject this foil to an electroplating action, preferably with copper, but, if desired, with platinum, tin, gold, or the like. An extremely thin layer of the electroplated metal is caused to be deposited on the opposite surfaces of the silver foil. A deposit of approximately two per cent, and preferably less, by weight, is sufficient for the present purposes. Measured in inches, where the thickness of the foil is about .001 inch, the thickness of the electroplated layer on each side of the foil will be no greater than .00001 inch.

The foregoing electroplating process has not been illustrated but will be readily understood by those skilled in the art. The configured foil may be expeditiously suspended in a suitable electroplating solution to accomplish the desired purpose.

After the foil has thus been conditioned, the three plies are nested together in the relationship shown in Figure 2, and are then reswaged, as a unitary assembly, under the action of the die 10 and its companion. This reswaging operation serves to press the plies firmly into mutual superposition, and has the further important effect (illustrated in Figures 3 and 4) of causing the intermediate silver foil to be squeezed into more intimate contact with the plies contacting its opposite sides.

Figures 3 and 4 are greatly exaggerated and greatly enlarged fragmentary cross-sections through the nested assembly before and after the reswaging operation. Inasmuch as the undersurfaces 14, 15, and 16 of the plies 11, 12, and 13, respectively, are each substantially identical with the configuration of the upper surface of the die 10, it follows that the upper surfaces of the respective plies, because of the thickness of each ply, are incapable of nesting with perfect accuracy when the plies are originally placed together. Minute gaps, such as those illustrated at 17 and 18, exist. During the reswaging operation, the intermediate ply 12 is deformed, by the pressure, into substantially the condition illustrated in Figure 4, whereby these gaps are filled in. This is, in any event, our belief as to what takes place during the reswaging operation.

The assembly is then subjected to a spot-welding operation, which preliminarily bonds the several layers together into a more permanent unit, and the result is then substantially of the character illustrated in Figure 5 which, it will be understood, is also exaggerated in thickness. The spots 19 represent the points at which spot-welding has taken place, and these welds are caused to take place at no specific points but merely at a number of judiciously selected points to insure the maintenance of the relative positions of the plies.

The assembly is then subjected to a heat treatment, preferably in an oven, and while this procedure has not been illustrated it will be understood by those skilled in the art. The heat is sufficient to cause a fusing of the intermediate ply, and, because of the lower fusibility of this ply, the other plies remain unaffected. The fusing temperature causes the intermediate ply to flow, and virtually to braze the main plies 12 and 13 together in an intimate manner. The fusing procedure is carried on in a hydrogen atmosphere.

After cooling, the denture base, which is now a completely integrated unit, is subjected to the further procedures which lead to the production of a complete denture. For example, upon ref-

erence to Figure 6, it will be observed that a mesh support 20 is soldered or welded onto the marginal portions which are to bear the artificial teeth. A wire or metal abutment 21 is then welded onto the base along the inner margin of the mesh support 20; and attachment material 22, bearing the artificial teeth 23, is then applied, this material being firmly held in position by its interengagement with the mesh support 20, and abutting along its inner margin against the shoulder 21.

Polishing and burnishing then completes the denture.

With reference to the electroplating procedure hereinbefore mentioned, we are not able at the present time to state with absolute certainty the reasons for its beneficial effects. It is our theory, however, that the copper or similar electroplated layer, because of its higher degree of "wettability", enhances the free flowing of the silver when the latter is fused. We refer, by the term "wettability" to the ability of a liquid to flow over and wet a solid with which it is in contact. This ability depends in large measure upon the adhesion tension between the liquid and the solid, and probably depends also upon the surface tension of the liquid.

An untreated silver foil is found to be deficient in its ability to "wet" the surfaces with which it is in contact. By conditioning it, however, by the electroplating procedure hereinbefore mentioned, its wettability is enhanced to a degree which makes the present process entirely feasible. During the fusing, the minute electroplated deposit undoubtedly alloys with the silver, but the added ingredient is present in such a small proportion that its presence, after the fusing, is practically inappreciable. Its beneficial effect arises from the fact that, while it is present as an alloying ingredient in only a minute proportion, it is concentrated in its entirety before the fusing on the exposed surfaces of the silver.

In certain cases, the intermediate bonding layer need not be conditioned in this manner, as will be readily understood. In the case of gold, for example, no electroplating procedure is necessary to enable a foil of gold or gold and silver alloy or the like to flow freely and to effect its bonding action with a maximum degree of efficiency.

It will also be understood that, under certain circumstances, the spot-welding procedure may be dispensed with.

The applicability of the invention to dentures other than "uppers" will be obvious from the foregoing description.

In general, it will be understood that changes in the details, herein described and illustrated for the purpose of explaining the nature of our invention, may be made by those skilled in the art without departing from the spirit and scope of the invention as expressed in the appended claims. It is, therefore, intended that these details be interpreted as illustrative, and not in a limiting sense.

Having thus described our invention, and illustrated its use, what we claim as new and desire to secure by Letters Patent is—

1. A metallic denture base comprising two nested plies of metallic denture base material coextensive in area with each other and individually swaged into conformity with the same uniquely irregular pattern, the inner ply being relatively weak but of great deformability, the outer ply

being less deformable but of greater strength, whereby the denture base is of adequate rigidity and has an inner surface bearing an accurate and detailed imprint of the pattern; and a fused spacer between the plies bonding them together into a completely integrated unit, said spacer comprising metallic foil coextensive in area with said plies and consisting of a metal of the group which includes silver, gold, and alloys thereof.

2. A denture base assembly consisting of three nested plies of sheet material individually swaged into conformity with the same uniquely irregular pattern, the inner ply being relatively weak but of great deformability, the outer ply being less deformable but of greater strength, and the intermediate ply being metal foil of relatively low fusibility and chosen from the group which includes silver, gold and alloys thereof.

3. A denture base assembly consisting of three nested plies of sheet material individually swaged into conformity with the same uniquely irregular pattern, the inner ply being relatively weak but of great deformability, the outer ply being less deformable but of greater strength, and the intermediate ply being a foil of silver electroplated with an extremely thin layer of a metal which conditions the silver to enhance its degree of wettability with respect to the other plies.

4. A denture base assembly consisting of three nested plies of sheet material individually swaged into conformity with the same uniquely irregular pattern, the inner ply being relatively weak but of great deformability, the outer ply being less deformable but of greater strength, and the intermediate ply being a foil of silver electroplated with an extremely thin layer of a metal of the group which includes copper, platinum, gold, and tin.

5. The method of making a metallic denture base with an inner surface bearing an accurate and detailed imprint of a uniquely irregular pattern, which consists in individually swaging into conformity with said pattern three plies of sheet material, one of said plies being of relatively thin metallic denture base material and hence relatively weak but of great deformability, another of said plies being of relatively thick metallic denture base material and hence of less deformability but relatively strong, the third ply being metal foil of relatively low fusibility chosen from the group which includes silver and gold, nesting said plies with the foil in the middle and the deformable ply on the inside, and fusing said foil to bond the plies into a completely integrated unit.

6. The method of making a metallic denture base with an inner surface bearing an accurate and detailed imprint of a uniquely irregular pattern, which consists in individually swaging into conformity with said pattern three plies of sheet material, one of said plies being of relatively thin metallic denture base material and hence relatively weak but of great deformability, another of said plies being of relatively thick metallic denture base material and hence of less deformability but relatively strong, the third ply being metal foil of relatively low fusibility chosen from the group which includes silver and gold, nesting said plies with the foil in the middle and the deformable ply on the inside, reswaging the nested assembly to squeeze the foil into more intimate contact with the plies on each side of it, spot-welding the assembly to bond the plies preliminarily, and subjecting the assembly to a heat

sufficient to fuse said foil, whereby the plies are bonded into a completely integrated unit.

7. The method of making a metallic denture base with an inner surface bearing an accurate and detailed imprint of a uniquely irregular pattern, which consists in individually swaging into conformity with said pattern three plies of sheet material, one of said plies being of relatively thin metallic denture base material and hence relatively weak but of great deformability, another of said plies being of relatively thick metallic denture base material and hence of less deformability but relatively strong, the third ply being metal foil of relatively low fusibility chosen from the class which includes silver and gold, nesting said plies with the foil in the middle and the deformable ply on the inside, reswaging the nested assembly to squeeze the foil into more intimate contact with the plies on each side of it, and subjecting the assembly to a heat sufficient to fuse said foil, thereby bonding the plies into a completely integrated unit.

8. The method of making a denture base with an inner surface bearing an accurate and detailed imprint of a uniquely irregular pattern, which consists in individually swaging into conformity with said pattern two plies of denture base material, one of said plies being relatively weak but of great deformability, the other ply being less deformable but of greater strength,

swaging a sheet of silver foil into conformity with said pattern, then electroplating said foil with an extremely thin layer of a metal which conditions said foil to enhance its wettability with respect to the other plies, nesting said plies with the conditioned silver foil in the middle and the deformable ply on the inside, and fusing said silver foil to bond the plies into a completely integrated unit.

9. The method of making a denture base with an inner surface bearing an accurate and detailed imprint of a uniquely irregular pattern, which consists in individually swaging into conformity with said pattern two plies of denture base material, one of said plies being relatively weak but of great deformability, the other ply being less deformable but of greater strength, swaging a sheet of silver foil into conformity with said pattern, then electroplating said foil with an extremely thin layer of a metal of the group which includes couper, platinum, gold, and tin, nesting said plies with the plated silver foil in the middle and the deformable ply on the inside, and fusing said silver foil, whereby an alloy is formed having a high degree of wettability with respect to the other plies, and whereby the latter are bonded together into a completely integrated unit.

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