June 15, 1971 E. M. PROSEN 3,585,064

UNITING OF FUSIBLE PORCELAIN TO A PRECIOUS METAL BASE MEMBER

Filed May 31, 1968

Fig. 1.

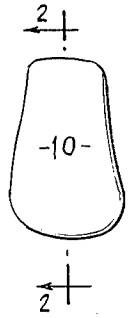


Fig. 2.

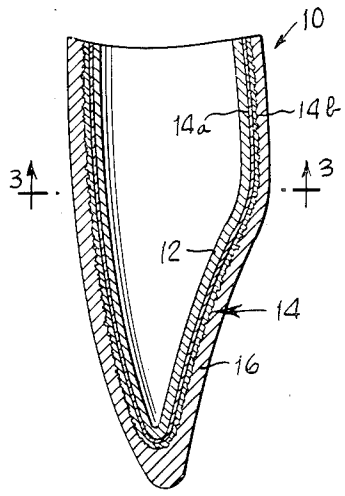


Fig. 3.

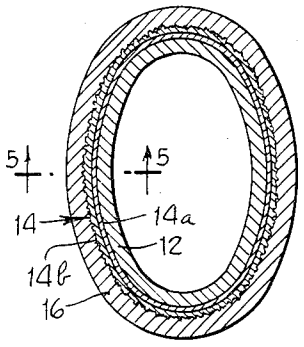


Fig. 4.

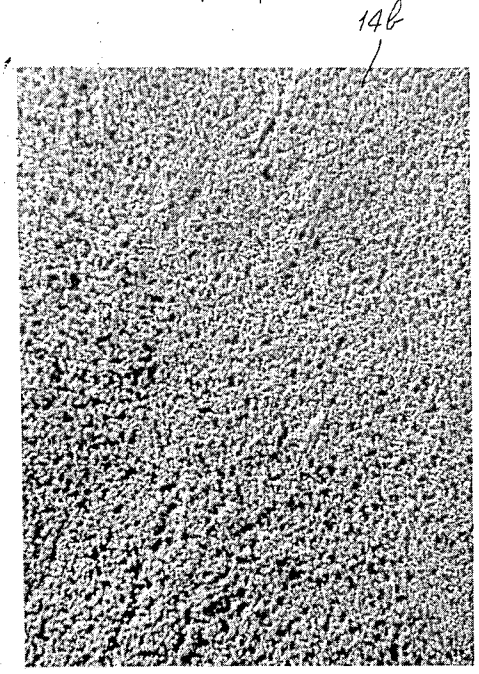
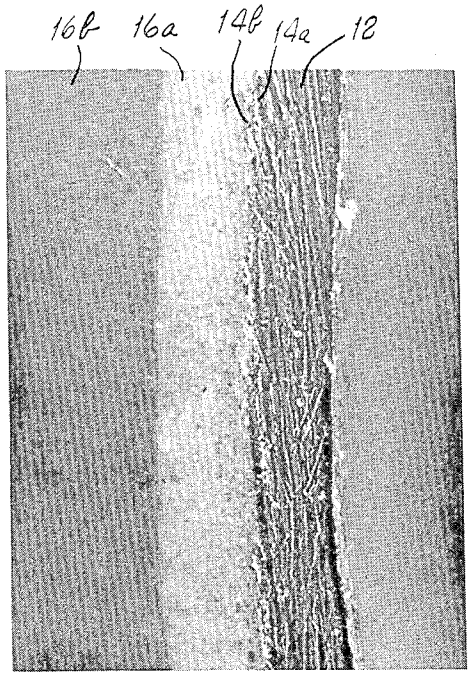


Fig. 5.



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UNITING OF FUSIBLE PORCELAIN TO A PRECIOUS METAL BASE MEMBER

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Int. Cl. B44d 1/14
U.S. Cl. 117—70C 5 Claims

ABSTRACT OF THE DISCLOSURE

Fusible porcelain is united in a thin layer to a precious metal base member by first forming on such precious metal base member a gold coat having a carpet-like, irregular surface composed of gold particles which are soldered or sweated to the base member and are laterally separated from each other, and then applying to such carpet-like, irregular surface a paste of a relatively low-fusing porcelain which upon being fused in situ is mechanically united to said carpet-like surface by interlocking to such gold particles. The interlock thus formed of the porcelain layer with the pure gold particles has been found to permit of limited differential expansion and contraction between the porcelain layer and the base member under the same heat conditions due to the fact that the pure gold particles yield with movement of the porcelain. There is also provided the novel composite structure of a precious metal base member, a gold coat layer having spaced gold particles soldered or sweated to the base member, and a porcelain layer interlocked to such gold coat particles.

The present invention relates to the uniting of fusible porcelain to a precious metal base member, and aims to provide certain improvements therein.

It is well known in the art that porcelain cannot be bonded by fusion to the surface of a precious metal base member, such as pure gold or platinum, for the reason that they do not form an oxide. Accordingly, in the art, and especially in the dental profession, when it was desired to bond porcelain to pure gold it was the usual practice to add iron or some other readily oxidizable metal to the gold to promote adhesion thereto of the porcelain. Such procedure, however, has not been entirely satisfactory because the expansion and contraction of gold and porcelain under the same heat conditions differ greatly and give rise to strains being set up in the porcelain, which strains become evident by crazing of the porcelain especially where present in a thin layer. Moreover, the bond between the oxide present in the gold and the porcelain is not as strong as desirable and the presence of the added oxide imparts, by reflected light, an unwanted coloration to the porcelain.

It is an object of the present invention to overcome the foregoing shortcomings of the prior art relating to the fusion of porcelain to a precious metal base member, especially pure gold, and to provide the composite structure of a precious metal base member, a gold particle layer soldered or sweated to the surface of such base member, and a fused porcelain layer firmly interlocked to such gold particle layer.

A further object of the invention is to provide a method of uniting fusible porcelain to a gold base member whereby the interlocking between such porcelain and base member is so strong as to render it practically impossible to physically separate the porcelain from the gold after being united thereon.

The foregoing and other objects of the invention, not specifically enumerated, will become evident and better understood from the detailed description which follows

when considered in connection with the accompanying drawing wherein:

FIG. 1 is a front elevation of an incisor tooth crown embodying the invention;

FIG. 2 is a longitudinal section taken along the line 2—2 of the tooth crown shown in FIG. 1;

FIG. 3 is a transverse section taken along the line 3—3 of FIG. 2;

FIG. 4 is a photo-micrograph of the surface of a gold coat formed in accordance with the invention, the photo-micrograph being made from a flat surface in order to get the proper focal depth to show the carpet-like, irregular surface appearance;

FIG. 5 is a photo-micrograph taken along the line 5—5 of FIG. 3.

Referring to the drawing, the invention is illustrated as applied to a porcelain facing on an incisor tooth crown **10**, which consists of a cast precious metal cap **12**, such as pure gold, upon the outer surface of which is formed a composite gold coat **14** consisting of a first gold deposit **14***a* and a second gold deposit **14***b*. Over the outer surface of the deposit **14***b* is formed a porcelain overlay **16** which is fused in situ and interlocked to the second gold deposit to provide a tooth-like body having the desired contour in relation to the companion teeth in a person's mouth.

The gold cap **12** is formed as a casting in accordance with well-known dental techniques.

The composite gold coat **14** is formed in two steps in the following manner: A viscous slurry or paste is first formed by mixing in proper proportion powdered pure gold of approximately 325 mesh, powdered silver of 400 mesh or finer, a fluxing composition and a suitable wetting agent. A combined fluxing and wetting agent which I have found suitable consists of the following constituents in approximately the following proportions: 12 grains sodium fluoride, 6 grains borax and 2 pennyweights ethylene glycol containing 6 grains of titanium oxide. The mixture is whipped in a blender to a creamy consistency and 2 pennyweights of the cream is added to 4 pennyweights of the powdered gold and 10 grains of the powdered silver, e.g., about 10% of silver in relation to the gold, and are thoroughly stirred to make a suitable paste. If found necessary this paste may be diluted with a drop or two of water or glycerine to render its consistency suitable. It is then painted on the area of the precious metal surface to which a porcelain facing is to be united (herein shown as the outer surface of the pure gold tooth crown **12**), then dried, the coated crown placed in a furnace, and the temperature of the furnace progressively elevated to 1945° F., the melting point of pure gold. In the presence of silver and the flux, the particles of gold may be induced to melt at approximately 1940° F. When the gold in the applied paste melts, it flashes and produces a gold alloy deposit which will be of lower carat gold and hence will have a lower melting point than pure gold. The flashed surface constitutes the first gold deposit **14***a*. The major portion of the fluxing agent will flow off from the flashed gold-silver alloy and any flux that remains may prove useful when fusing thereon the second gold deposit **14***b*.

To form the gold deposit **14***b* a second application of the aforementioned slurry or paste is painted on the surface of the cooled first deposit **14***a* to provide thereon a layer containing gold particles which are separated from one another by the titanium oxide contained in combination with the flux. The second applied paste layer is then thoroughly dried, the crown placed in the furnace and the temperature thereof progressively elevated. Here again as in the preparation of the first deposit **14***a* the 10% silver in the paste starts to melt at about 1769° F. and gravitates into contact with the alloy deposit **14***a*, while the gold particles are held in

temperature by the titanium oxide in the flux. As the temperature in the furnace approaches 1915° F. and all the silver will have become molten and the major portion of the flux and the titanium oxide will have become molten and flowed off from the article, the temperature is lowered immediately or the article is removed from the furnace. The gold particles are not permitted to melt, hence upon cooling, the gold particles become permanently bonded to the first deposit or sweated to the first deposit by the intermediary of the new molten silver.

suspension by the titanium oxide in the flux. As the temperature in the furnace approaches 1915° F. and all the silver will have become molten and the major portion of the flux and the titanium oxide will have become molten and flowed off from the article, the temperature is lowered immediately or the article is removed from the furnace. The gold particles are not permitted to melt, hence upon cooling, the gold particles become permanently bonded to the first deposit or sweated to the first deposit by the intermediary of the new molten silver.

(a) applying to such precious metal surface a first coat of a slurry which comprises powdered pure gold powdered silver of about 10% by weight of about 10% to the gold, and a flux

(b) heating the coated article to a temperature sufficient to melt the silver but not the gold, and a flux

(c) applying to such precious metal surface a first coat of a slurry which comprises powdered pure gold powdered silver of about 10% by weight of about 10% to the gold, and a flux

(d) heating the coated article to a temperature sufficient to melt the silver but not the gold, and a flux

paste entering into the spaces in the irregular surface and covering said surface, and

(h) fusing the porcelain paste in situ to cause an interlocking of the porcelain with the gold coat, whereby expansion and contraction of the porcelain layer can take place independently of the expansion and contraction of the gold coat upon which it is united when subjected to the same temperature conditions.

4. A method according to claim 3 wherein the powdered pure gold and powdered silver in the slurry is in the proportion of 4 pennyweights of gold to 10 grains of silver.

5. A method according to claim 3 wherein the flux and wetting agent consists of ethylene glycol, titanium dioxide, sodium fluoride and borax.

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ALFRED L. LEAVITT, Primary Examiner

C. K. WEIFFENBACH, Assistant Examiner

U.S. Cl. X.R.

117—70A, 71M, 94

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,585,064 Dated June 15, 1971

Inventor(s) EMIL M. PROSEN

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Abstract of the Disclosure

Column 1, line 20, after "carpet-like" insert ---
, irregular ---

Signed and sealed this 25th day of April 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334