CHAPTER 9

The Full Veneer Finish line Crown Used in Combination With Porcelain for Cosmetic Restorations

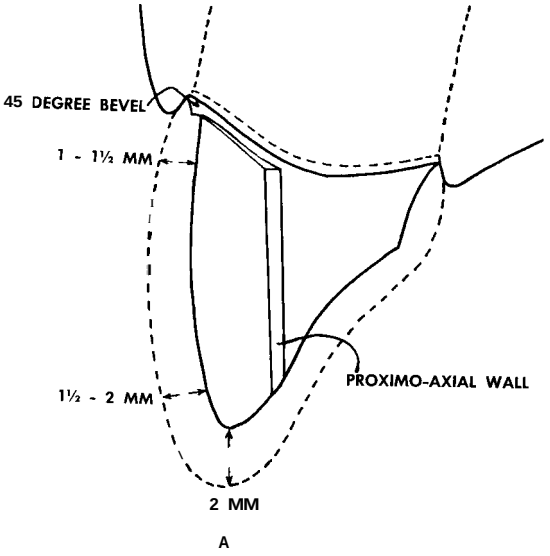
Introduction

The full veneer finish line crown in combination with baked porcelain has proved to be a durable cosmetic restoration of lost tooth structure. The full crown imparts the greatest possible strength to badly broken down tooth structure and may be designed to permit adequate thickness of metal to protect the porcelain facing, without losing esthetic appearance. While satisfactory esthetics can be attained initially with plastic type facings in these restorations, baked porcelain is tolerated better by the soft tissues and offers a far more lasting result.

The full veneer gold crown with a porcelain facing is often the restoration of choice both for a single tooth and for a supporting abutment. This design is also indicated where the maxillary anterior teeth require full coverage, and the patient has an excessive overbite with little or no over-jet. In such cases, untoward directional forces are brought to bear against the lingual surfaces of these teeth which may contra-indicate the use of porcelain jacket crowns.

Preparation

The design of the preparation for a full veneer porcelain faced crown may be described as follows: After adequate incisal or occlusal reduction has been made, a veneer of enamel is removed from the axial surfaces of the tooth. The design of the lingual half of the preparation is identical to the typical veneer crown. (ref. Chapter 8). The lingual as well as both proximal surfaces of the tooth present a tapered finish line. There must be greater reduction of tooth structure on the labial or buccal surface to allow room for thickness of the facing. The added reduction of tooth structure extends to approximately the midline of the mesial and distal surfaces of the tooth where it ends in definite mesio and disto-axial walls. This reduction is similar to that of the porcelain jacket crown preparation. A gingival shoulder approximately 1 mm. in width is placed under the free gingiva on the labial or buccal surface of the tooth and is extended to the mesio and disto-axial walls. The outer one-half of the shoulder is beveled at about a 45° angle to provide a margin that will insure a better fit of the casting.



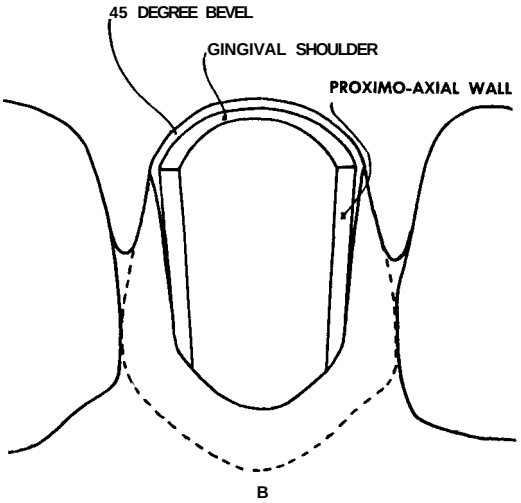


ILLUSTRATION No. 1

A. Proximal view of preparation on maxillary cuspid.
B. Labio-gingival view of preparation of maxillary cuspid.

The porcelain facing may be fabricated by either of two methods:

A. Fabrication of Facing From a Denture Tooth

1. Select proper shade and mould of denture tooth (diatoric or pin type).

2. Reduce pins and hollow grind lingual surface of facing using a suitable size diamond or carborundum wheel stone. Ample lubrication with Vaseline or glycerine will minimize tendency of porcelain to chip or fracture.

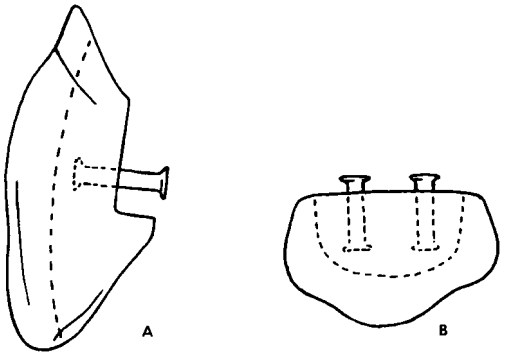


ILLUSTRATION No. 2

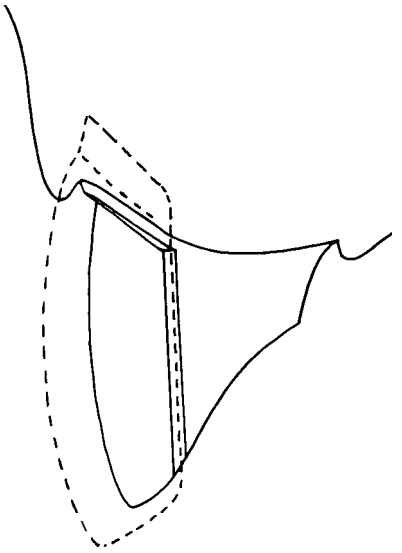
A. Proximal view of pin facing.

B. Incisal view of pin facing.

C. Hollow grinding facing with diamond stone.

3. Apply powdered graphite or soft pencil lead to the labial or buccal surface of the die in the working model.

4. Position the facing against the working die and attain internal markings by applying a slight rubbing motion. Closer adaptation and axial alignment of the facing is accomplished by grinding the indicated areas.



POSITION OF FACING

ILLUSTRATION No. 3

Denture tooth positioned against die after initial grinding.

5. Before obtaining the final axial alignment, reduce the ridge-lap portion of the facing to approximate the position of the gingival shoulder of the die. At the same time adjust the incisal or occlusal length of the facing to approximately the desired clearance.

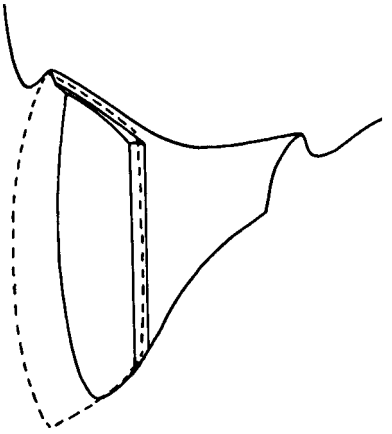


ILLUSTRATION No. 4

Approximate axial, gingival and incisal alignment of facing after reduction of gingival and incisal portions of facing.

6. Obtain final axial alignment by careful marking and hollow grinding.

7. Secure facing in position with a small amount of sticky wax and make a plaster core on the labial or buccal surface of the working model to hold the facing in place. Trim the plaster core one to two millimeters short of the incisal or occlusal edge of the facing.

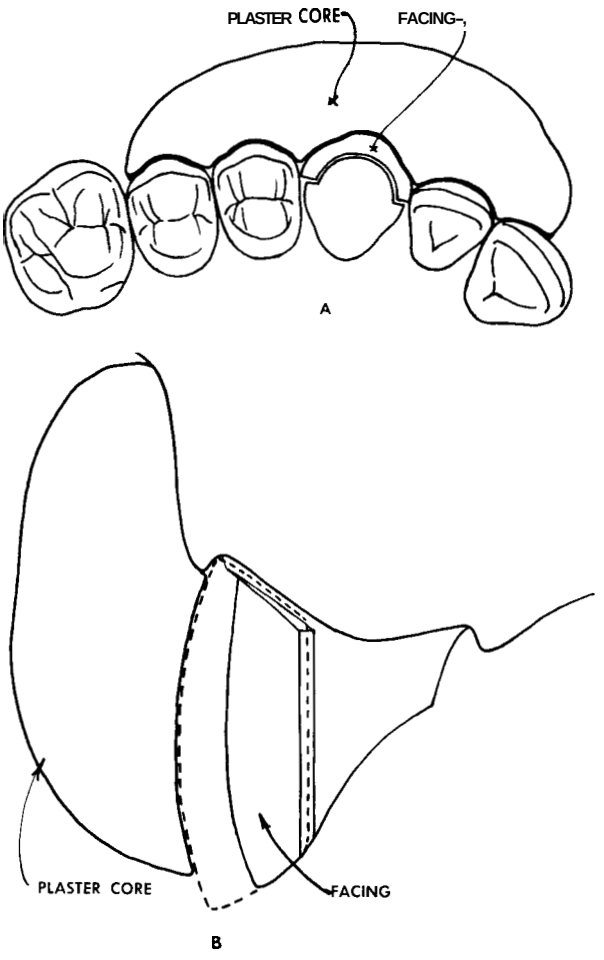


ILLUSTRATION No. **5**

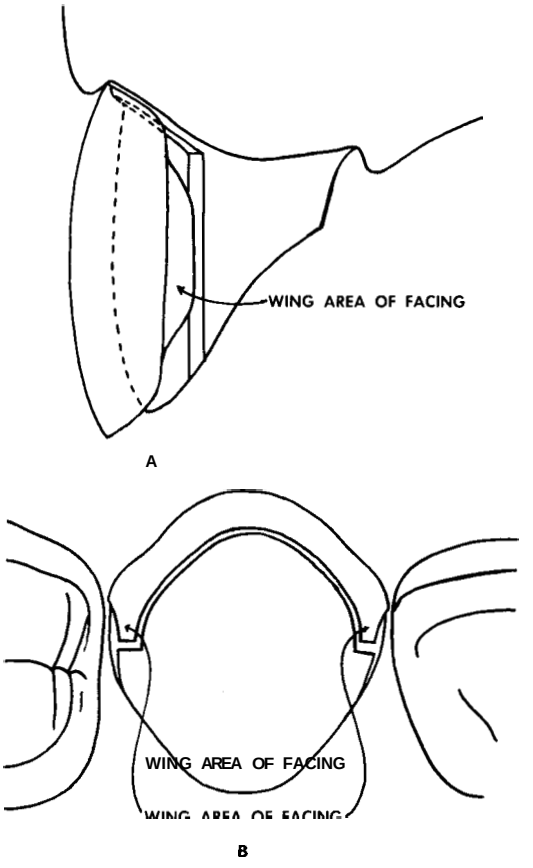
A Incisal view of plaster core

B Proximal view of plaster core.

8. Hold the facing in position with the plaster core and adjust the length of the incisal or occlusal edge to provide approximately 1 mm. clearance.

9. Adjust the gingival wall of the facing to permit ¾ mm. clearance for gold. The gingival and incisal or occlusal walls of the facing must have a slight taper in the lingual direction to allow withdrawal of the facing from the wax pattern and to permit reseating the facing into the casting. Excessive taper of the gingival and the incisal or occlusal walls of the facing will reduce its retention in the casting.

10. The mesial and distal portions of the facing extend well into the proximal embrasures. This extension prevents display of gold and provides sufficient porcelain for the shaping of **retention wings.** The retention wings are tapered in such a manner that they will extend into a recess of the casting.



A. Proximal view of retention wings.

B. Incisal view of retention wings.

A Variation

When added retention is necessary to retain the facing in the casting, the ends of the wings may be flattened to permit the drilling of small holes .022 inch in diameter.

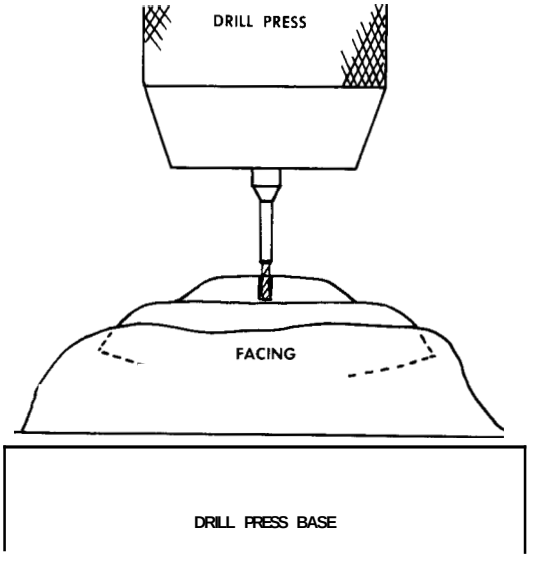


ILLUSTRATION No. 7

Facing mounted in drill press.

Nylon bristles .020 inch in diameter are fitted into these holes. The end of the bristle must extend slightly beyond the facing to permit firm attachment to the wax pattern.

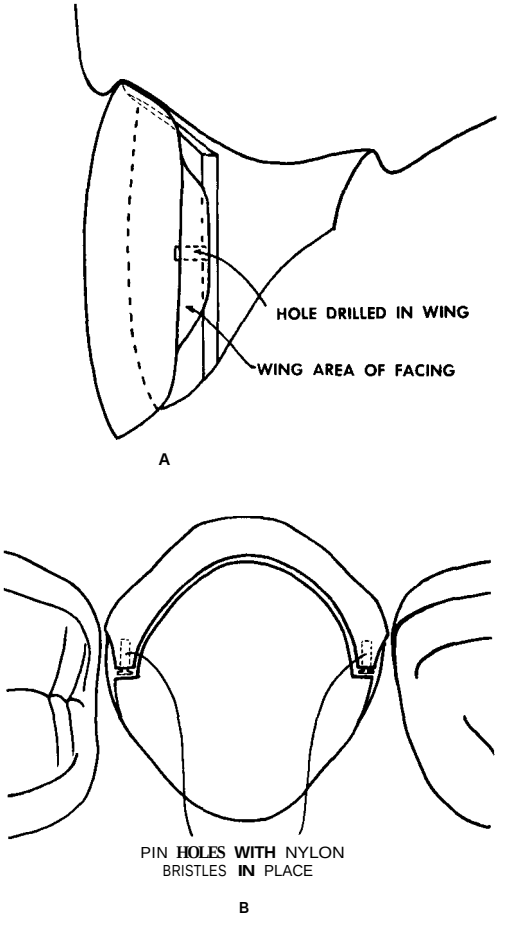


ILLUSTRATION No. 8

A. Proximal view of pin holes.

B. Incisal view of pin holes.

These small pins become part of the casting and afford much greater retention for the porcelain facing.

11. In the final refinement of the margins of the facing, make certain that any sharp angles are removed. However, all cavo-surface margins should be sharp and definite to facilitate waxing the pattern and dressing the gold to the porcelain in the final fitting of the casting. Adequate incisal or occlusal coverage of the porcelain with gold is necessary to prevent injury to the facing.

12. Warm the working model, die, facing, and plaster core by placing in hot water. Lubricate the warmed facing and die. With the facing positioned inside the plaster core, drop molten wax onto its internal surface and immediately position the core and facing onto the working model. Now flow wax onto the remaining surfaces of the die to establish the final contour of the wax pattern. Establish the final adaptation of the margins using Kerr's Wax-up wax.

13. Use a piece of sticky wax to remove the facing from the wax pattern.

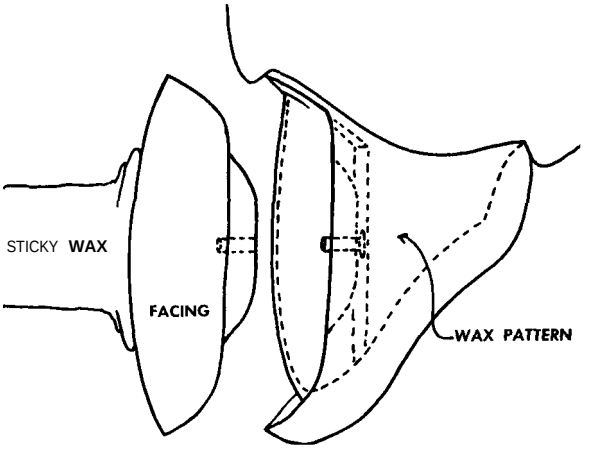


ILLUSTRATION No. 9

Removing facing from wax pattern with sticky wax.

14. Attach a hollow sprue to the center of the wax pattern just gingival to the incisal edge.

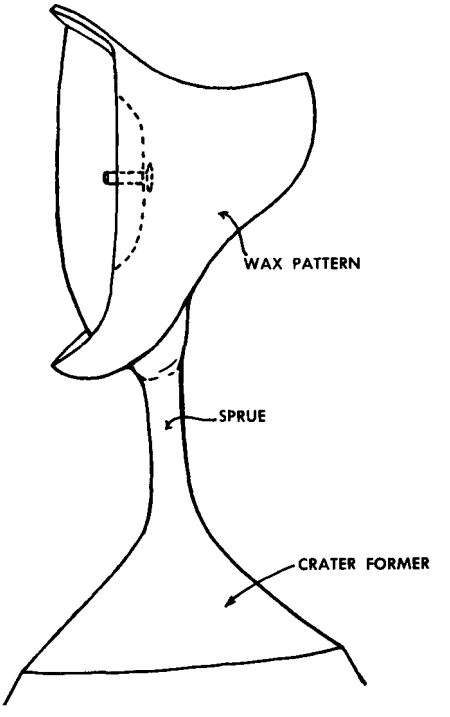


ILLUSTRATION No. 10

Sprue attached to wax pattern.

15. Carefully remove the wax pattern, invest, burn out and cast. After the casting is made it should be thoroughly cleansed and etched before attempting to fit the facing into the window of the casting.

B. Fabrication of Facing Using a Modification of the Hagen Technique*

1. Wax the crown to full contour on the working model.
2. Cut a labial window in the wax with sufficient extension of its margins in all directions to minimize the display of gold. This will provide adequate room for porcelain in the proximal areas to permit the designing of retention wings on the porcelain facing.
3. In establishing the window, leave a layer of wax approximately 0.2 mm. thick over the labial surface of the die.
4. Make an impression of the labial surface of the wax pattern and its window using rubber base impression material. From this impression fabricate a stone or electroplated die.
5. Adapt platinum foil to the die and fabricate a porcelain facing to fit the labial window. The procedures of opaquing, building, condensing, and fusing the porcelain are similar to those used in making a porcelain inlay.
6. Try the porcelain facing into the window of the waxed crown.
7. Prepare the mesial and distal wings of the facing to minimize the display of gold and to provide for retention as **described under technique A.** Where added retention is needed, flatten the ends of the wings to permit drilling small diameter holes as described in technique A.
8. Make all cavo-surface margins of the facing continuous and remove any sharp angles which might tend to result in fracture of the facing.
9. Fit nylon bristles to the holes and complete the wax-up of the crown.
10. Use a piece of sticky wax to remove the facing from the wax pattern.
11. Attach a hollow sprue to the center of the wax pattern **just** gingival to the incisal edge.
12. Carefully remove the wax pattern, invest, burn-out and cast. After the casting is made it should be thoroughly cleansed and etched **before attempting** to fit the facing into the window of the casting.

Excellent esthetics can be attained by either technique.

(*) W. H. B. Hagen; Combination Gold and Porcelain Crown; J. Pros. Dentistry, 10:325-329, *1960.*

PORCELAIN FUSED ONTO VENEER CASTINGS

Introduction

In recent years specially fabricated porcelains and high-fusing alloys have been developed that can be successfully bonded. These esthetic, durable restorations can be utilized for individual crowns, supporting abutments, and bridge pontics. A number of such materials are available. The restorations may be designed in several ways. The porcelain may cover the greater portion of the crown or it may be baked into a prepared window. "The baked in" facing technique is particularly advantageous for posterior restorations where it is desirable to maintain **the occlusal contacting surfaces in metal.** To establish color compatibility with other gold restorations in the mouth, the exposed metal surfaces may be gold plated. The gold plating process can be easily accomplished by using a stripping unit (refer Chapter 7) in a reverse procedure. An ingot of 22-karat casting gold is grasped in the anode clip and immersed in the cyanide solution. The bridge or restoartion to be plated is grasped in the cathode clip and immersed in the solution. The thickness of the gold plate deposited will depend upon the time factor. The internal surfaces and the margins of the casting can be protected against plating provided the temperature of the solution is not elevated too high.

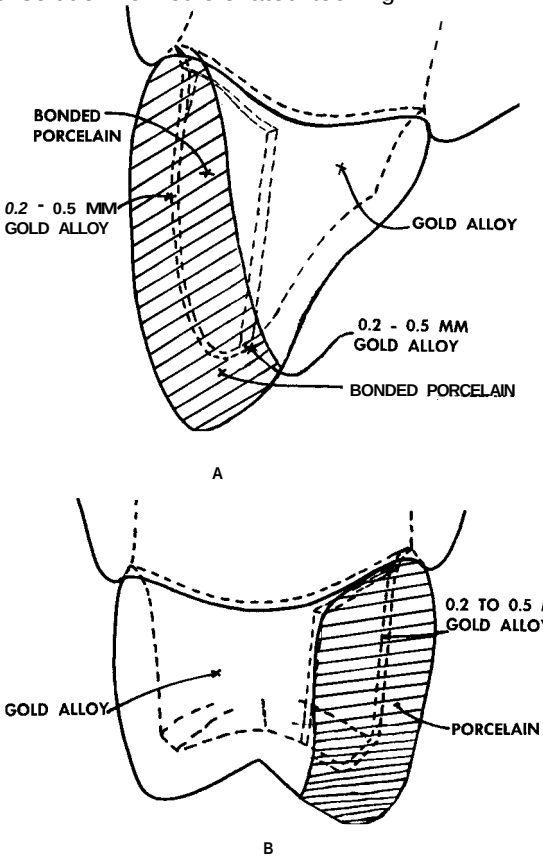


ILLUSTRATION No. 11

A. Design of restoration with partial coverage of porcelain.

B. "Baked in facing" design with occlusal established in metal.

Preparation

The design of the preparation is the same as for a full veneer gold crown with a porcelain facing fabricated from a denture tooth. (Page 153, Illustration No. 1)

A tapered-barrel shaped diamond stone with a rounded end is used to reduce enamel on the labial and lingual aspect of the tooth. The gingival finish line is initially established at approximately the height of the gingival crest. **A** small diameter flame shaped diamond stone is employed to establish the interproximal finish line which is continuous with the champered finish lines of the labio or bucco-gingival and linguo-gingival surfaces of the tooth. There should be approximately 2mm of reduction of tooth structure incisally or occlusally. One and one-half millimeters reduction is necessary on the labial or buccal and interproximal surfaces where the porcelain veneer is to be added. The metal of the casting in these areas should be approximately *0.2* to 0.5 mm in thickness.

A small diameter tapered carbide bur is now used to establish a gingival shoulder approximately 1mm wide at the level or slightly below the gingival crest. The shoulder is extended well into the interproximal regions and ends in definite mesio and disto-axial walls. Before extending the final finish line of the preparation well beneath the crest of the free gingiva it is recommended that tissue be now retracted. **A** small tightly wrapped strand of cotton yarn is tucked beneath the gingiva. This is covered with a larger strand of cotton which is tucked tightly over the smaller strand as a pressure pack. Both strands of cotton remain in position for a sufficient length of time to prevent injury of the gingival crest during final instrumentation. The larger strand of yarn is removed and the outer one-half of the shoulder is beveled at about a 45° angle with a short flame-shaped diamond stone.

The purpose of the gingival shoulder and axial walls is to provide bulk of metal in strategic areas of the casting. These areas of increased thickness act as buttresses to resist distortion of the casting due to dimentional changes of the porcelain veneer during firing.

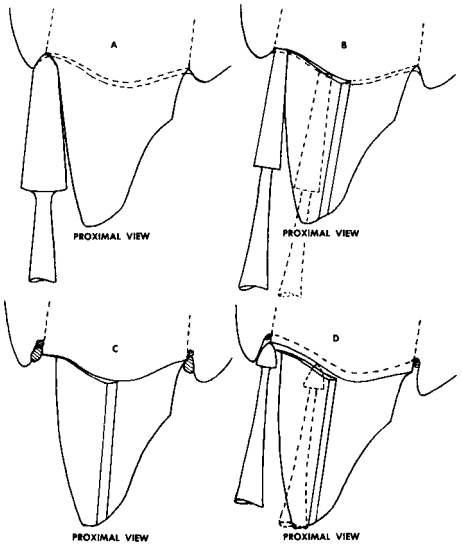


ILLUSTRATION No. **12**

A. Establish the labio or bucco-gingival finish line with a tapering barrel-shaped diamond. A small diameter flame-shaped didmond stone is used to establish the interproximal finish line.

B. **A** small diameter tapered carbide bur is used to establish a gingival shoulder. The shoulder is extended well into the intro-proximal region.

C. **A** small tightly wrapped strand of cotton yarn is tucked beneath the gingival. This is covered with a larger strand of cotton which is tucked tightly over the smaller strand. This remains until sufficient retraction is obtained to protect the tissue to be retracted.

D. The outer one-half of the shoulder is beveled at about a 45° angle with a short flame-shaped diamond.

Waxing

Patterns should be waxed to a minimum thickness of 0.2 to 0.5 mm. in the areas to be covered with porcelain. Sharp angles should also be avoided in these areas. Special attention must be directed toward accurate adaptation of the wax to the finish line of the preparation. This procedure is difficult since the bulk or thickness of wax in the region of the finish line is much thinner than for the typical veneer crown. A 10-gauge sprue should be used to secure the pattern to the crucible former.

Investina. Castina and Treatment of the Casting

Specially formulated investments must be used with higher melting point alloys to produce accurate castings. The manufacturer's instructions should be specifically followed when using these products. Any changes in the alloys either by contamination or mishandling may lead to ultimate failure. Ordinary gold alloys do not have linear coefficients of expansion or melting temperatures which are compatible with the coefficient of expansion and fusing temperature of porcelain. The special alloys employed are formulated to provide a coefficient of linear expansion which is compatible with that of the special porcelain (1.45%). Essentially the copper content of regular gold alloy is replaced with increased percentages of platinum, palladium, and very small percentages of other elements. The purposes of re-alloying are to raise the melting point of the casting gold (to approximately 2250" F.) sufficiently above the fusing temperature of the special porcelains (approximately 1850" F.) and to establish the same coefficient of linear expansion as the porcelain.

The porcelains compounded for this purpose contain 70+% silica which is necessary to establish the desired linear coefficient of expansion of 1.45%.

The metal should always be melted in a crucible used exclusively for this purpose to avoid contamination from undesirable elements contained in ordinary cast gold alloys. Excessive casting pressure will cause breakdown of the investment with resulting roughness on the surfaces of the casting. For this reason it is advisable to use a minimum number of turns with centrifugal casting machines. Excessive and prolonged heating of the metal in the crucible should be avoided.

After the casting is made and thoroughly cleansed, it is lightly etched mechanically and fitted to the prepared tooth. There are definite advantages to adjusting the casting in the mouth before the porcelain is baked onto the metal. This makes it possible to determine the fit at the gingival finish line of the preparation more accurately. Also, adjustments and complete seating of the casting can be accomplished without danger of injuring the thin overlay of porcelain near the gingival margins. If the initial seating onto the tooth is done after the porcelain is baked on, injury to the porcelain will sometimes occur in this area.

It has been an accepted procedure to place the casting in hydrofluoric acid for a number of hours before the bake on process is begun. The acid bath eliminates organic materials and occluded gases which might cause porosity in the porcelain. Following the acid treatment, pliers should be used in handling the casting to avoid additional contamination.

Gold Coating the Surfaces of the Casting.

It is a consensus of opinion that bonding porcelain onto metal is greatly enhanced by fusing or soldering a thin coat of pure gold onto the specified surfaces of the casting. First, carborundum stones are used to remove any sharp corners or edges of the casting which might induce fracture lines in the porcelain and to produce a clean surface free from oxides and contamination. A preparation of finely divided pure gold and silica flux in a glycerine vehicle is painted onto the freshened surfaces of the casting. The casting is placed into a porcelain oven and the temperature is elevated to the melting point of pure gold (1945" F.) to complete the soldering process. While the casting is still heated it is plunged into water to explode the silica flux off of the pure gold surface. Complete removal of the flux particles is accomplished by warming the casting and immersing it in a 50% solution of hydrochloric acid several times. The casting is now ready for the application of porcelain.

Applying and Firing the Porcelain

There are three materials used for building the veneer of porcelain onto the gold casting:

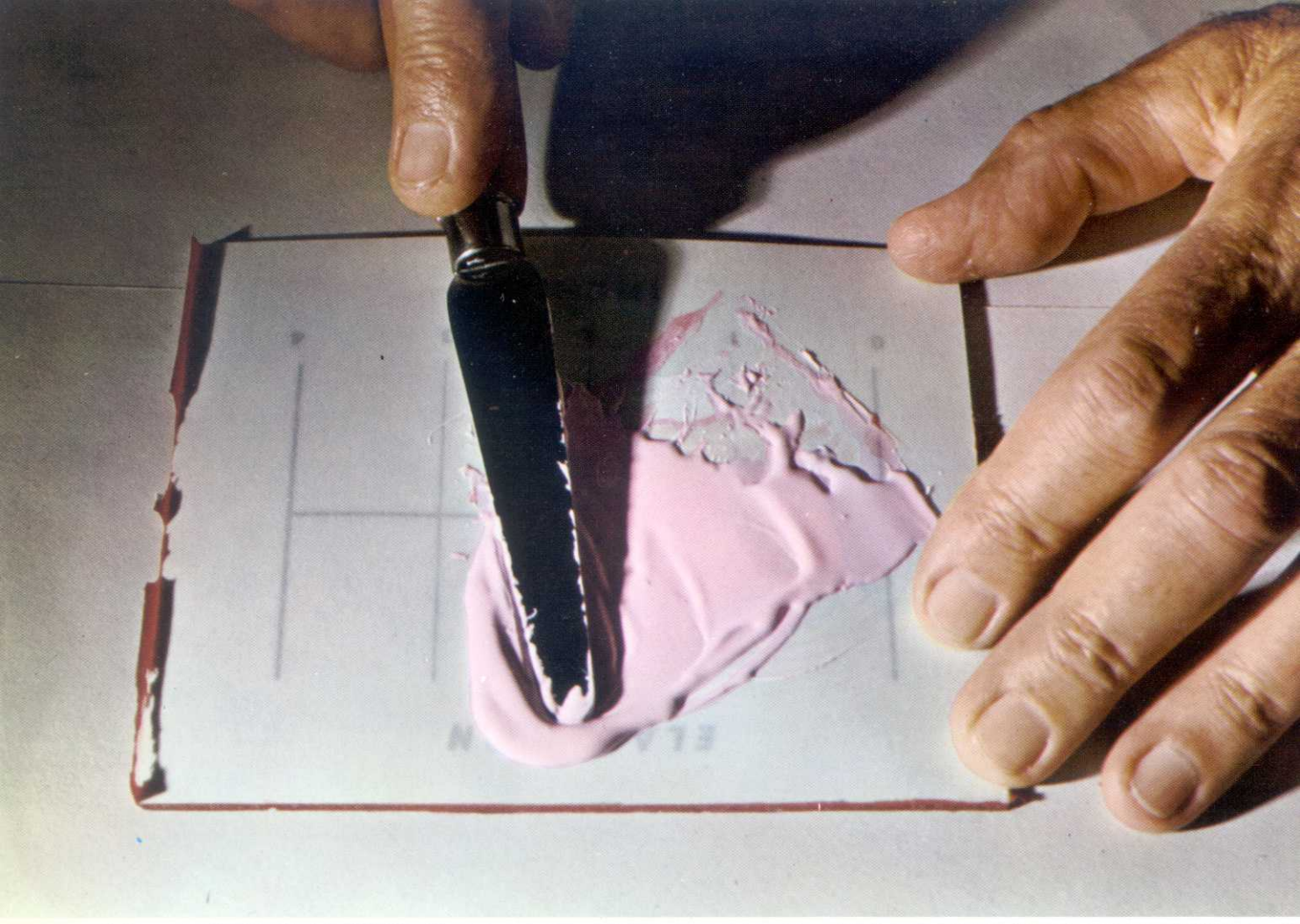
1) Opaque porcelain
2) Gingival porcelain
3) Incisal porcelain

The opaque porcelain serves a two-fold purpose. Its principle function *is* to mask out the color of the underlying gold. Its fusing property is primarily responsible for bonding the porcelain to the metal. The bonding of porcelain to metal is primarily accomplished by a "compression mechanism" of the porcelain as it changes from a liquid to a solid state. As the porcelain sets, extreme forces of compression lock the mass into and around any irregularities even of a microscopic dimension. One of the most accepted theories maintains that an infinite number of "miscells" or microscopic pockets attach themselves to the metal as the mass cools creating minute vacuum chambers that aid in locking the porcelain onto the metal surface.

The gingival porcelain provides the body shade which can be altered with modifiers. The incisal shade provides the translucency of the incisal edge. After the metal has been completely opaqued, the building and firing of the balance of the porcelain is accomplished in a manner similar to that used in fabricating a porcelain jacket crown. It should be pointed out that cleanliness in porcelain procedures cannot be overemphasized. The hands, instruments, and working area should be free from contamination. The porcelain should be built to excess contour and fired to a biscuit bake. The margins and details of anatomy are refined at this time by selective grinding. A final glaze is established by employing a controlled technique of firing time and temperature. Porcelain stains can be employed for further characterizing of the porcelain, It should be emphasized that vacuum firing is important in achieving color stability during the firing process. Strict adherence to the manufacturer's recommendations as to the firing cycle is mandatory for the best esthetic results.

"Bake on" porcelains are now being compounded which are fused at a temperature considerably higher (2300-2400" F.) than that used in producing the present "fritted" porcelains (1400-1500" F.). In the initial firing of these products at high temperatures they become true porcelains instead of "fritts" (glass compounds) before being ground and prepared for dispensing. Essentially the higher range of firing in the manufacture of porcelain products eliminates gases and organic material. This method of manufacture produces porcelains which have higher density and greater translucency. Improvements are also being made in the color stability of porcelains by utilizing higher fusing metallic oxides in the place of less stable products. No doubt rapid improvements will continue to be made in the manufacture and techniques employed with these widely used products.

Porcelain fused onto cast gold restorations satisfies a real need in modern restorative treatment. Careful diagnosis will determine the conditions under which this type of restoration is indicated.



TOP PLATE

Mixing heavy-bodied elasticon.

BOTTOM PLATE

Full veneer crown impression, using controlled tube technique.