

## UNITED STATES PATENT OFFICE

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## COMPOSITION FOR DENTAL CASTING PATTERNS

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My invention relates to new and useful improvements in composition for making rigid dental casting patterns and a method of forming dental molds and has for its object to facilitate the making of a dental casting mold from a rigid pattern of thermoplastic or millable material and dental casting wax in combination, in the making of which mold the rigid pattern will be entirely reduced to a gas at a lesser temperature than that heretofore employed for rigid patterns, and the dental casting wax reduced at the same temperatures used previously in the art, the mold being vented by a sprue hole to entirely free it of all residual deposits of casting wax and rigid pattern material, and the time at which the mold is cleared of all rigid pattern material is readily ascertainable. The time at which the mold is cleared of casting wax is well known in the dental art.

Rigid dental casting patterns are understood to be preformed parts that may by slight manipulation be adapted to the working models of the individual dental case and by still further additions thereto of dental waxes, may be made into complete patterns for metal dental castings.

Dental casting patterns for various appliances in dentistry, such as lingual and palatal bars, crown forms, namely, central and lateral incisor, bicuspid, cuspid, and molar forms, backing patterns for various types of interchangeable slip on facing teeth, and cylindrical pins for tube teeth, are old in the art.

These patterns in the past have been made in waxes, resins and cellulose materials, both of the nitrate and acetate. Each of said materials presented faults that made the various patterns objectionable for their intended use. The waxes were found to be too soft in hot weather and too brittle in cold weather and at all times patterns made of these materials were not strong enough to be handled easily without breakage.

The various resins in use up to this time presented some of the same faults as the waxes with the additional one of forming a carbonaceous or ash residue in the casting mold upon the burn out, which in some instances required extreme and prolonged temperatures to volatilize and dissipate the pattern from the mold, and in other instances it was impossible to remove the ash content entirely by any dental heating means.

The cellulose materials, both the nitrate and acetate, although having sufficient strength, showed the fault of forming carbon in the mold in the burn out which again required extreme

high prolonged temperatures to volatilize. The nitrate, by violent burning within the mold, caused disintegration of the surface, an additional objectionable feature. Both of these materials were also objectionable in that contact with water caused warpage of, and swelling in, the wet molds. Also, all the aforesaid materials become flexible at so low temperatures that by making hot additions of casting waxes, they were many times caused to warp or change shape, which was a further disadvantage.

Due to these various unfavorable characteristics materials were sought that showed no such faults, and in experimentation it was found that certain resinous polymerized derivatives of acrylic acid and methacrylic acid favorably filled the exacting requirements in every respect. Although there are possibly several polymerized derivatives of these acids that can be used, it has been found that the polymerized product of monomeric alpha methyl methacrylate, namely, polymeric alpha methyl methacrylate resin fulfills the needs, and its characteristics relative to this invention will be given, and it will be offered, as an example of the several derivatives of these acids which might be used for dental patterns and whereas this chemical is the only one herein completely described it is proclaimed that it is offered as an example of those having the necessary characteristics of related chemicals for dental casting patterns. Polymerized tertiary butyl acrylate is also cited as a utilizable material of acrylic acid derivation. Meta styrene, a chemical in another group is also cited as having the necessary favorable properties and may also be used.

The above said chemicals are usually water clear, transparent thermoplastic solids, very strong, easily molded or milled into rigid casting patterns, and easily modified by heat to suit the demands of the individual dental case. They overcome the objectionable characteristics of materials used in the past for rigid casting patterns, namely, they are unaffected by water and therefore, do not warp and swell in the wet molds. Due to a higher softening point than other materials used in the past, namely, 190 degrees to 212 degrees Fahrenheit, they do not change shape upon the addition of hot casting wax. This softening temperature or point at which the materials may be bent for use on the individual case, is above the molten stage of dental casting wax, which is approximately 135 degrees Fahrenheit. At temperatures below 325 degrees F. these materials go from a solid to a softened mass to a

liquid stage and then pass directly into a gas vapor which is driven from the mold either by expansion or diffusion or both, leaving no detrimental residuum of either carbon or ash in the mold, nor with their use is there any harmful disintegration of the mold. Detrimental residuum is understood to mean any substance that would cause a defective casting or would be combined in the casting to cause a noticeable flaw or void.

10 No greater temperature than 825 degrees F. is required to dissipate the materials from the molds. The materials are not materially absorbed by the mold investments when in a molten stage, a condition that goes to more rapid volatilization than with old materials so absorbed. Although the materials are thermoplastic in their nature and would generally be molded in hot molds, they may also be milled by hot or cold cutters. Certain patterns may be made from the materials

20 by being drawn through a die plate. Other patterns may be formed by extruding the material through proper openings under heat and pressure. The materials are not combustible in the molds but go into a vapor which may be conducted off, stored and later combusted, or the gas may be burned outside the sprue hole.

Because carbon or ash was formed in the molds in which resins and cellulose materials heretofore were used, no exact time could be determined when all the residual content had been driven from the mold. At temperatures as low as 600 to 625 the acrylic and methacrylic acid derivatives begin to vaporize with the production of a characteristic pungent vapor or gas. Should the temperature be maintained at this degree the gas so formed will be insufficient to burn at the sprue hole opening. At the time the pungent gas can no longer be detected by smelling at the sprue hole opening the mold is sufficiently free from the rigid pattern material that a casting can then be made, all due consideration being given the wax portion of the pattern. This phenomenon, in which a pungent gas is formed and dissipated, may be taken as a definite signal or guide as to

45 when the mold is free from the rigid pattern and as such is an improvement in type of materials used for rigid patterns, in as much as the presence and lack of odor can be detected by the nose, which means the presence or lack of detrimental residuum in the mold.

Practically all dental heating equipment used for burning patterns from investment molds produce rapid and high temperatures at least 1000 degrees F. and upward.

55 Should the temperature of such appliance be uncontrolled, the following conditions arise. As the casting ring contents approach the temperature of 600 degrees F. the pungent gas is detected. At temperatures below 800 degrees F. and not necessarily exceeding 825 degrees F. the rigid patterns become softened or liquid, then either at the same time or in rapid succession the pungent gas is formed in sufficient quantities to burn at the sprue hole opening. Immediately after this gas stops burning at the sprue hole the rigid pattern has been, for all practical dental purposes, completely volatilized and dissipated from the mold. This series of conditions again results in a rigid pattern having a definite guide as to the time at which it is entirely driven from the mold and a definite guide as to when the mold is in condition to receive gold, due consideration being given to the time necessary to eject the wax content when such content is present in the mold.

75 The meta styrene compound passes through

the same series of reactions when heated rapidly as do the acrylic and methacrylic derivatives named, and what applies and is described for these acid derivatives when heated rapidly will also apply to meta styrene.

It is understood that the thermoplastic patterns may be made of combinations of the described thermoplastics and related groups of chemicals, either mixtures, solidified solutions or reactionary products wherein the spirit of the invention is the same and the results similar. Combinations may be made by mixing various different granules of the related groups, or by mixing the different related chemicals while hot and fluid, or by polymerization together, the purpose being to modify the known chemical nature, namely, to make the patterns more flexible, softer, harder or more volatile, adhesive, etc.

It is understood that the casting pattern materials described, although clear, may be treated to appear opaque, white, black or any of the primary or complementary colors by the addition of proper agents either before or during polymerization or to the ground molding powders. It is a marked advantage to have the materials in various colors. It is found that the various slotted facing teeth have slots of varying sizes, these differences being so slight that they are difficult to measure with the unaided eye. Using colored pattern materials the color itself may be used to designate a pattern of one size, another color another size. Thus, an opaque pattern would represent a pattern having the smallest pin for the smallest slot, a white or black pattern would represent a larger pin and red or blue a third size pin, etc. In colored thermoplastic casting pattern materials a distinct advantage is had and as such is an improvement in such thermoplastic materials.

It is found that during the burn out in the casting ring of all the aforesaid thermoplastics a negligible amount of stain or unidentified residual discoloration remains on or in the mold wall and somewhat in the investment material, but this stain or discoloration is in no way detrimental to the finished metal casting and in no way plays a part in the invention.

My composition for dental patterns is usable in the same manner as are the other compositions made for that use, that is, the rigid patterns are first adapted to the dental case, then to form the proper finished pattern for the completed gold casting, dental casting wax may be added to the rigid patterns to bring them to the desired form. It is understood that wax is also rigid when cold. The term rigid being used to designate the preformed part of the entire pattern from the wax part of said pattern and when so used will have only this meaning. In using rigid patterns for interchangeable slip on tooth facings, casting wax is added to the rigid pattern to bring out the desired anatomical form of the entire tooth. With lingual or palatal bar patterns, casting wax is added to the dental model to form gum saddles, tooth supports, clasps, etc. In using tube teeth the cylindrical posts are attached at one end into the gum saddle by wax, the remainder of the post passing through the tube tooth. In using various crown form patterns, wax is added to vary the anatomical form to fit the individual case and also to make a perfect fit of the crown form as made to the model of the prepared tooth stump. All the above operations are well known in the dental art.

The combination rigid and wax pattern when properly formed is placed in the investment molding material in the usual casting ring and when the investment is set the ring is placed in a heating device. The combination pattern is thus driven from the mold in the casting ring. The temperatures and reactions in driving the dental wax from the mold in the casting ring are well understood in the art and need no explanation.

However, with my composition for the rigid portion of the combination pattern, a lesser degree of heat than heretofore used need be employed to drive this part of the pattern from the hot mold. I have found it satisfactory to use a temperature not to exceed 825 degrees F. to completely drive the rigid pattern from the mold, whereas in the past temperatures materially above 825 degrees F. up to 2000 degrees F. were necessary to rid the mold of the rigid portion of the combination pattern, and in some instances no heating appliance in dental appliances could complete this result.

It is understood that rigid patterns of my material may be used without the combination or addition of casting wax and when used in this manner castings may be made at the temperatures previously made known, as soon as the gas stops burning at the sprue hole opening or when no further pungent odor is present.

It is further found that dental casting wax becomes vapor and in certain heating appliances this gas or vapor may burn at the sprue hole opening. However, this gas is formed before the rigid pattern of my composition becomes gaseous. The time that the gas from the wax is formed and dissipated is well understood in the dental art and needs no further discussion.

Having thus fully described my invention what I claim and desire to secure by Letters Patent is:

1. A rigid thermoplastic dental pattern material composed of a polymerized resin having the characteristics of being reducible to a gas within the mold at a temperature below 825° F. without leaving any detrimental residuum deposit, and selected from a group consisting of meta styrene, resinous polymerized derivatives of acrylic acid, and resinous polymerized derivatives of methacrylic acid.

2. A thermoplastic dental pattern material composed of a polymeric alpha methyl methacrylate resin.

3. A thermoplastic dental pattern material composed of a composition of a polymerized tertiary butyl acrylate.

4. A thermoplastic dental pattern material composed of a composition of meta styrene.

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