June 17, 1941. C. S. BALLARD 2,245,849

PRODUCTION OF THERMOPLASTIC DENTURES

Filed Feb. 28, 1938 2 Sheets-Sheet 1

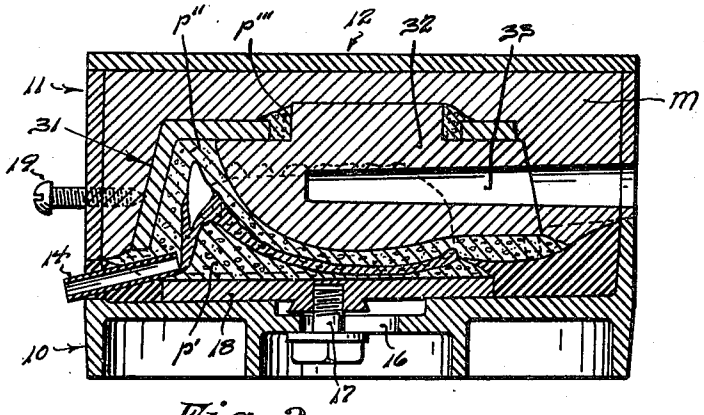


Fig. 2.

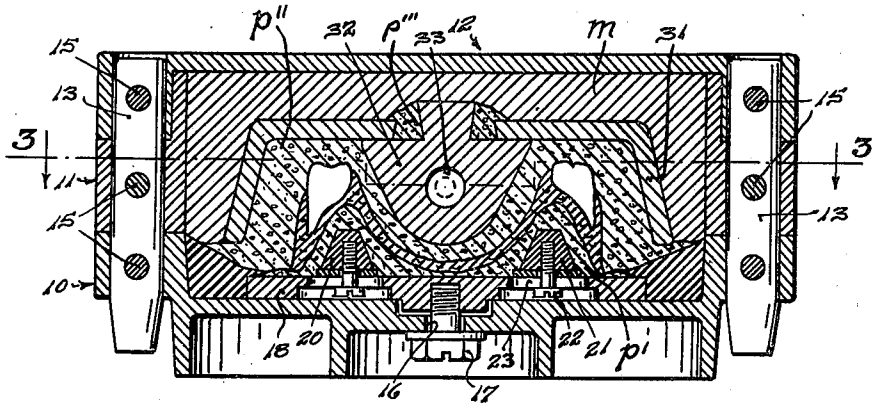


Fig. 1.

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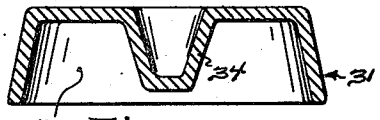


Fig. 6.

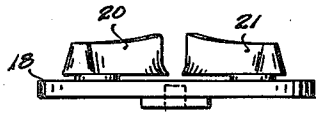


Fig. 5.

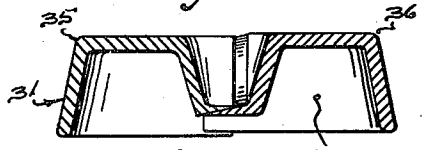


Fig. 8.

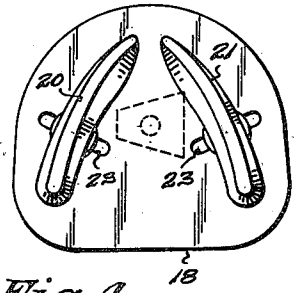


Fig. 4.

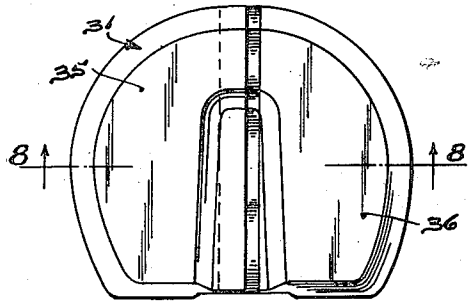


Fig. 7.

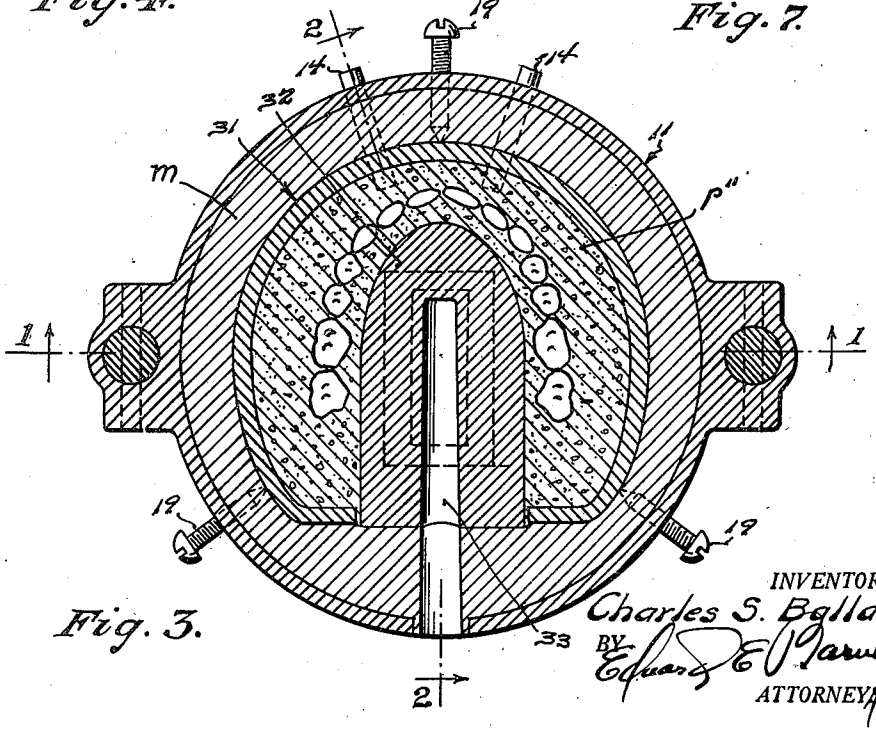


Fig. 3.

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UNITED STATES PATENT OFFICE

2,245,849

PRODUCTION OF THERMOPLASTIC DENTURES

Charles S. Ballard, Seattle, Wash.

Application February 28, 1938, Serial No. 193,052

5 Claims. (Cl. 18—55.1)

This invention relates to improvements in the manufacture of artificial dentures and is especially directed to advancements over the invention illustrated and described in my issued Letters Patent of the United States No. 2,171,736, of September 5, 1939.

Referring in more particularity to such issued patent in order that the objects and advantages of the present improvements may be better understood, I would point out that my prior technique consisted in preparing a wax model of the denture; mounting the same on a plaster replica of the ridge or arch for which the denture is being made and within a flask investing the surfaces of this mounted model with lead or other metallic foil, leaving the teeth exposed; protecting the exposed teeth by applying a small amount of plaster around the same and introducing over the wet plaster a pair of metal horseshoe-shaped arch plates; pouring about the foil and the plaster-set plates a molten metal having a relatively low melting point and one less than the metal of the foil, the heat therefrom serving to melt the wax; opening the flask and replacing the melted wax with a blank of thermo-plastic denture material; closing the flask as much as the blank will allow; and, coincident with the application of heat to the flask for flowing the denture material, applying pressure upon the flask to close the same and force the material over and around the exposed roots of the teeth, following which the flask is permitted to cool and the parts thereof separated and the completed rough denture removed.

While this foregoing technique constituted a very major stride forward in the art, there are several objections, both from the angle of the technician's work and the denture produced. Considering these disadvantages, probably foremost in a relatively low heat conductivity through the mass of metal within the flask which results in an adverse concentration of heat to the plaster holding the teeth to the arch plates, tending to a disintegration of the plaster which particularly is noticeable where a thin plaster mix is employed. A further objection lies in the porous condition of the mass of metal, resulting from escape of steam from the wet plaster rising through the metal being poured, causing the flowing denture material under the influence of pressure to express the surrounding foil into the metal pores and thereby develop denture burrs which oppose removal from the flask and increase the work of milling the product. A still further objection is found, that of time and care necessary to apply the foil properly over the surface of the wax model.

Each of these several disadvantages I overcome by the simple expedient of providing a preformed member shaped to provide a cavity generally following the surface contour of a denture and which is produced from a material of high heat conductivity and one which is proof against deformation under the temperature conditions of the molding process, a material; such, for example, as aluminum, and applying this member in the manner of an investient cap, with a minimum of wet plaster or equivalent matrix-forming lining therein, over the wax denture model to lie in intervening relation as between the model and a mass of metal poured in a molten state into the flask—the heat which later is applied to the flask toward building up the retained heat of the set mass being transmitted to the denture blank by the pre-formed investient cap. Considering, more especially, the heat conduction characteristic of aluminum (.3435) as compared to that of the fusible lead (.0836), it is readily apparent that the utilization of the intervening heat-transmitting member of aluminum or other like or suitable metal more effectively distributes the heat and thereby uniformly flows the thermo-plastic to obviate, from the finished denture, the presence of internal strains which reduce resistance to the many stresses to which dentures are subjected in use. Otherwise stated, my pre-formed cap member carries the heat uniformly to the denture and, by effecting an equal flow of the material in the pallatal as well as the teeth-gripping arch portion thereof, eliminates spot temperatures which are responsible for the development of internal strains.

My invention therefore consists in the provision of a denture-investing cap pre-formed from a relatively non-fusible and highly conductive material and one which in use is proof against temperature-induced contraction or expansion, aluminum being considered most practical, a cap which descriptively can best be defined as a denture-investing relation-retainer, and in the advanced technique permitted by the use of such cap in practicing the process of producing artificial dentures, as will be hereinafter described and claimed.

In the drawings:

Figure 1 is a transverse vertical section taken on the line 1—1 of Fig. 3 to illustrate a denture being processed in a flask with which is employed a denture-investing relation-retainer

constructed according to one embodiment of the present invention.

Fig. 2 is a longitudinal vertical section thereof taken on the line 2—2 of Fig. 3.

Fig. 3 is a horizontal section on 3—3 of Fig. 1.

Fig. 4 is a top plan view illustrating the metallic model base which I show in the preceding views, detached from the flask, such model base complementing the relation-retainer which is the essence of the present invention.

Fig. 5 is an edge elevation of such model base.

Fig. 6 is a transverse vertical section illustrating an embodiment of a denture-investing relation-retainer modified from the showing of this cap member in Figs. 1 through 3.

Fig. 7 is a plan view showing a still different embodiment; and

Fig. 8 is a transverse vertical section taken on the line 8—8 of Fig. 7.

All of the parts used to practice my improved technique are, with the exception of the preformed relation-retainer, substantially the same as I illustrate and describe in my above-identified co-pending patent application, the flask comprising a lower half 10 and an upper open-top-and-bottom half 11 which in use is closed by a cover plate 12. The flask elements register, one with the other, and for that purpose provide aligned vertical sockets disposed at diametrically opposite sides to receive pins 13, the pins and the flask parts being horizontally pierced for the introduction of tapered pins 15 for locking the parts in position. In the lower half 10 are a pair of notches or saddle-sockets for the reception of flow tubes 14 by which waste model wax is extruded from the flask in the heat process of separating the model from the plaster-invested teeth.

The flask part 10 provides a diametrical slot 16 in its bottom-forming end wall and in this slot is received a threaded bolt 17 for securing a metallic model base, denoted generally by 18, in adjusted relation to the flask. Detailed in Figs. 4 and 5, said model base is designed to have a plaster replica of the ridge or arch for which the denture is being made produced thereon and to support this ridge or arch provides backing elements 20—21 arranged to be fixed in adjusted relation by threaded pivot pins 22 acting in floor slots 23 disposed angularly to one another. I illustrate a wedge-shaped block projecting from the underside of the model base, the purpose thereof being to fit an inversely-designed socket formed in an articulator.

Consider now the relation-retainer constituting the essence of the present invention, it will be seen that the same is formed as an incasement providing a horseshoe-shaped cavity in the form of a trough 30 defined about the perimeter by a scarp-like wall 31 and at the inside by a depressed center block 32 which, in Figs. 1 through 3, is represented as being shiftable horizontally and secured in adjusted position by plaster or the like p'''. Such movable block, for heat conduction, shoulders against the underside of the incasement and is bored as at 33 for the introduction of a thermometer.

In Fig. 6 I indicate a simplified design having the heat-conducting block formed as a center well 34 integral with the incasement proper, and in Figs. 7 and 8 is represented a somewhat similarly designed modification in which the incasement is divided on the longitudinal median line into a pair of complementary cap elements 35—36 laterally expandible with relation to one another. Of the three forms disclosed, the solid casting depicted in Fig. 6 is preferred and I find that a set of three sizes easily accommodates substantially all sizes and shapes of dentures ordinarily encountered.

In applying the wax model over the model base with a plaster film p' therebetween, and in the application of the pre-formed relation-retainer over the model with a plaster film p'' between the same, only a minimum of plaster remains between these outer metal and inner wax parts as distinguished from the exaggerated films of plaster disclosed in the drawings. Shifting of the relation-retainer is prevented by screws 19 working in the flask part 11.

The simplified technique permitted by the use of a pre-formed denture incasement produced from a material such as aluminum characterized by a melting point appreciably higher than the working temperature employed and lying relatively high in the scale of heat conduction, and especially an incasement of which a center extension thereof extends into close proximity of the pallatal portion of the denture to be produced, should be clear from the foregoing description and the preceding comparative analysis as between the present advancements and my prior improvements in the art of denture making. In practicing this technique, it may be desirable to apply a layer of foil over the aluminum incasement with the edges thereof extending outwardly as a surrounding skirt which lies between the lower and the upper halves of the flask, the purpose of this laterally-extending skirt being to direct steam outwardly between the flask parts rather than upwardly through the metal being poured, thereby to eliminate the presence of steam-developed "blisters" on the upper surface of the metal mass with consequent difficulty in capping the flask. A similar result may be accomplished by forming the aluminum incasement with an integral skirt disposed as a lateral extension of the lower edge. The letter m in the drawings denotes the mass of metal such as a lead-tin-antimony alloy and which, in a molten state, is poured into the flask and over the preformed denture incasement, this poured mass, as described, acting in the later processing of the denture to conduct the applied denture-flowing heat to the denture incasement which, in turn, carries the same most effectively to the denture material.

I wish it to be understood that no unnecessary limitations are to be implied from the foregoing description as it is my intention to limit or restrict the scope of the invention only as such limitations or restrictions are brought into the claims to distinguish my present advancements from the prior state of the art. In such claims, for example, the term "flow heat" in reference to the temperature transmitted to the denture material is intended to refer to that degree of heat which is necessary to convert the material into a condition which will define the denture cavity by the act of closing the mold. It is apparent that, while this flow heat referred to might be such as to actually develop a fluid condition of the denture material, a heat of lower intensity capable of developing only a plastic condition is clearly embraced in the claim scope by the language "flow heat."

What I claim is:

1. The process of forming a mold for the production of a denture of synthetic resin or like thermoplastic material, consisting in providing

a mold incasement from a metal relatively high in heat conductivity and of a shape describing only generally the denture to be made, adapting the incasement to the work by lining the cavity of the incasement with a minimum of plaster and while plastic forming the matrix therefrom by compressing the incasement over a wax model of the denture, and allowing the plaster to set and then melting the wax of the model from the matrix by pouring over the incasement a molten metal having a melting point appreciably lower than the metal of the incasement but sufficiently high to prevent deformation under application of a flow heat to a blank of the denture-forming material introduced to the mold.

2. The process of molding a denture of synthetic resin or like thermo-plastic material using a metallic mold incasement of a metal relatively high in heat conductivity and formed to a shape describing only generally the denture to be made, consisting in adapting the incasement to the work by lining the cavity thereof with a minimum of plaster and while in its plastic state producing a matrix therefrom by compressing the incasement over a wax model of the denture, allowing the plaster to set and then melting the wax by pouring over the incasement a molten metal of a melting point appreciably lower than the metal of the incasement but sufficiently high to prevent deformation under application of a flow heat to a blank of the denture material, replacing the melted wax of the model with a blank of the denture material, applying to the denture blank by conduction through the metal of the incasement sufficient heat to flow the denture material, and, co-incident with the flow of the material, applying pressure to close the mold.

3. The process of molding a denture of synthetic resin or like thermo-plastic material by the employment of a metallic mold incasement of a metal relatively high in heat conductivity and of a shape describing generally the denture to be made, said process consisting in the steps of adapting the incasement by lining the mold cavity thereof with a minimum of plaster and while in its plastic state producing a matrix therefrom by compressing the incasement over a wax model of the denture, allowing the plaster to set and then melting the wax by pouring over the incasement a molten metal of a melting point less than the metal of the incasement but sufficiently high to prevent deformation in the presence of a heat sufficient to flow a blank of the denture material, replacing the melted wax of the model with a blank of said denture material, and applying to the denture blank by conduction through the metal of the incasement a heat adequate to flow the denture material.

4. The process of forming a mold for the production of a denture of synthetic resin or like thermo-plastic material, consisting in providing a mold incasement from a material having a high melting point and high heat conductivity and of a shape describing only generally the denture to be made, adapting the incasement to the work by lining the cavity of the incasement with a minimum of a material capable of being set from a plastic state and while such material is in its plastic state forming the matrix therefrom by compressing the incasement over a wax model of the denture, and allowing the lining material to set and then melting the wax of the model from the matrix by pouring over the incasement a molten metal having a melting point lower than the material of the incasement but sufficiently high to prevent deformation under application of a flow heat to a blank of the denture-forming material introduced to the mold.

5. The process of molding a denture of synthetic resin or like thermo-plastic material by the employment of a mold incasement of a shape describing only generally the denture to be made and characterized in that the said incasement is highly heat conductive and proof against deformation under the temperature conditions of the molding process: said process consisting in the steps of adapting the incasement to the work by lining the mold cavity thereof with a minimum of a material capable of being set from a plastic state and while such material is in its plastic state forming a matrix therefrom by compressing the incasement over a wax model of the denture, allowing said lining material to set and then melting the wax of the model by pouring over the incasement a molten metal of a melting point sufficiently high to prevent deformation in the presence of a heat sufficient to flow said denture material, replacing the melted wax of the model with the denture material, and applying to the denture material by conduction through the incasement a heat adequate to flow said denture material.

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