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APPARATUS FOR CERAMIC WORK IN PROSTHETIC DENTISTRY

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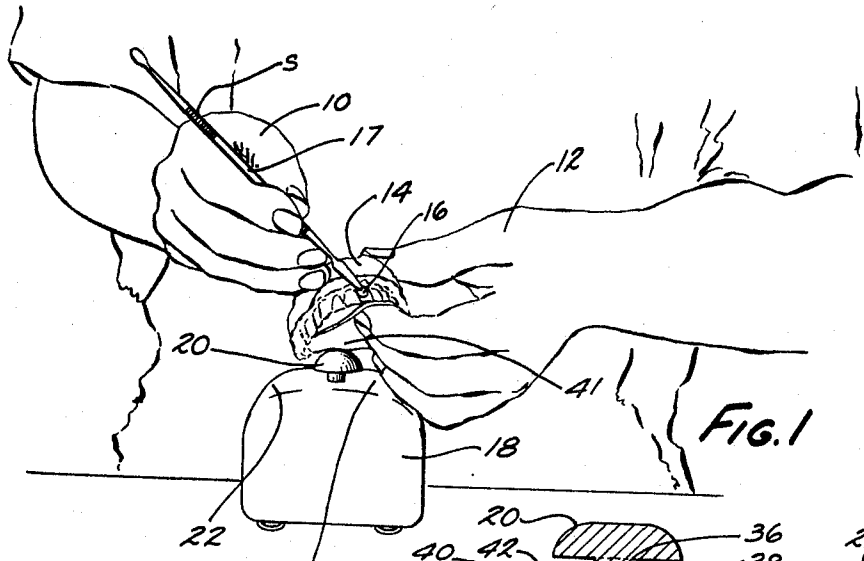


FIG. 1

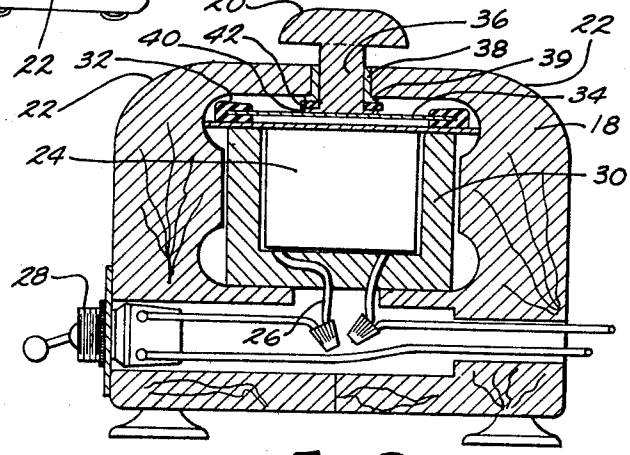


FIG. 3

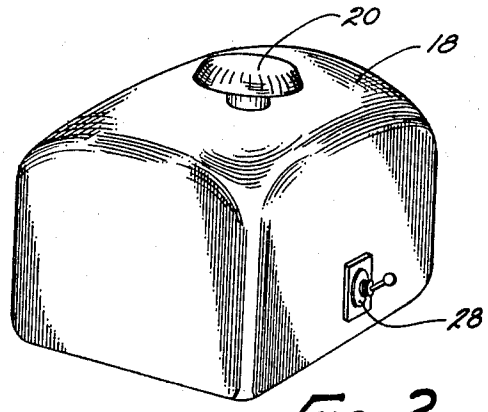


FIG. 2

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APPARATUS FOR CERAMIC WORK IN PROSTHETIC DENTISTRY

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Original application Mar. 15, 1962, Ser. No. 179,976, now Patent No. 3,229,003, dated Jan. 11, 1966. Divided and this application Apr. 5, 1965, Ser. No. 454,236

1 Claim. (Cl. 259—91)

This application is a divisional application of the parent application entitled Method and Apparatus for Ceramic Work in Prosthetic Dentistry, filed March 15, 1962, Serial No. 179,976, by Robert G. Bowman, now Patent No. 3,229,003.

This invention relates to apparatus for building ceramic crowns and bridgework, and more particularly to apparatus for coating a die surface or matrix with a ceramic material, especially for applying dental porcelain to a die surface or matrix on a tooth cast. In the following description and claim, it should be understood that any reference to crowns should be taken to include ceramic bridgework made by the same method.

An important factor in determining the health, well being and appearance of people is the physical condition and appearance of their teeth. Custom-made jacket crowns are an important part of this factor. However, the most skillfully hand-made crowns do not ordinarily possess the most desirable characteristics, both structurally and esthetically, due to limitations in the usual methods of forming this coating. Optimum characteristics of jacket crowns involve (1) strength, (2) durability, and (3) appearance (to closely resemble natural tooth enamel), i.e. good translucency, color, fluorescence, and refraction. To obtain these qualities in desired amounts in the finished product, (i.e. after firing), the immature porcelain coating (i.e. before firing) must be both extremely dense and of substantial thickness. With conventional hand coating methods in which the porcelain is condensed by rubbing a serrated portion (S in FIG. 1 of the drawings) of a tool against the cast, it is practically impossible to obtain optimum amounts of all three qualities because these methods do not permit sufficient condensation and dehydration of the porcelain. With the present methods, the immature porcelain coating must be made thicker than the desired thickness of the finished product to compensate for the rather substantial shrinkage during the firing process. Proper anticipation of the amount of shrinkage and proper compensation for it calls for considerable skill and experience on the part of the laboratory technician. Even then, with conventional methods and apparatus of forming the ceramic coatings of jacket crowns, shrinkage control is so poor that a substantial amount of hand grinding of the finished crown is usually necessary.

Furthermore, an improperly condensed porcelain coating has a tendency to crumble during the forming operation. This is particularly true of a completely ceramic crown (i.e. without gold backing) built up on a platinum matrix.

Most high-quality jacket crowns are composed of several layers of porcelain of varying colors and consistencies which must be applied in varying thicknesses at varying locations on the die or matrix to produce color and translucency gradients in the finished crown that most nearly resemble those of natural teeth. A serious problem in this respect is the necessity of condensing each

such layer gradually enough to retain its shape and thickness gradient, yet sufficiently to prevent it from "running" or spreading uncontrollably when another layer is applied over it. Present methods are very poor in this respect.

Finally, uneven or insufficient condensation of the porcelain causes the enamel to become "milky" and brittle upon firing. This condition is not apparent while the porcelain is in its immature state and therefore usually results in loss of a great deal of valuable labor.

The present invention solves all these problems by providing means for applying uniform vibration of controllable intensity to the cast and die or matrix. This makes it possible, by repeated vibration and fluid removal steps, to gradually condense each layer of porcelain to a much firmer and more uniform consistency than was heretofore possible without causing it to "run" uncontrollably during the condensation process. The resulting increased density and hardness of the immature porcelain makes the unfired jacket much easier to shape, and shrinkage during firing is greatly reduced. In addition, the homogeneity of the porcelain and the precise location of the various layers gives the fired enamel a far better and more natural appearance than was heretofore possible.

It is therefore the primary object of this invention to provide a novel apparatus for forming a ceramic coating or jacket on a crown die surface or matrix so that the finished crown is durable, strong, has unusually fine esthetic qualities, and can be accurately shaped and dimensioned with a minimum of labor.

Another object of the invention is to enable the immature ceramic coating or jacket to be firm and dense with excellent definition between the layers of the coating without sacrifice of bonding between adjacent layers.

A further object of the invention is to produce a jacket crown which has better light refraction and translucency characteristics than was previously possible, so as to appear extremely natural.

It is still another object of the invention to provide excellent shrinkage control of the enamel coating upon firing so as to reduce subsequent hand grinding to little or nothing.

These and other objects of this invention will be apparent upon studying the following specification in conjunction with the drawings, in which:

FIG. 1 is a perspective view showing the novel apparatus of this invention, including a vibrator and a tooth cast;

FIG. 2 is a perspective enlarged view of the vibrator illustrated in FIG. 1; and

FIG. 3 is a cross-sectional view of FIG. 2.

Basically, the method of making jacket crowns involved with the novel apparatus achieves a dense, thick ceramic coating with sharply defined but well bonded layers on a die or matrix, by intermittently applying small quantities of a suspension of ceramic material to the die surface, and holding the case against the anvil of the novel device, thereby subjecting the cast supporting the die or matrix to a mechanical vibration of uniform frequency on the order of sixty cycles per second to precipitate and condense particles of the ceramic material. The carrying fluid which has collected on the surface of the precipitated ceramic material is then removed, whereupon the cast is re-vibrated more intensely than before. The accumulated fluid is then again removed, and the process is repeated with more and more intense vibration until the ceramic material has become dense and hard. The ceramic material is then shaped with a finishing tool and

fired, usually in a vacuum, to form the finished enamel. The intermittent application of the suspension followed by several vibration and fluid removal steps is repeated a number of times to obtain the desired thickness and layer arrangement of the jacket crown.

The inventive apparatus comprises an electromagnetic vibrator including a housing, an electrical coil adapted to be connected to a conventional electrical outlet, a magnetic core, a spring vibrated by the magnetic flux in the core at an intensity dependent upon the spacing between the spring and the core, an anvil resting against the spring and protruding above the housing, and a hand rest and reference area adjacent the anvil. The vibration created by the vibrator is applied to a cast which includes the die or matrix to be coated, and the technician's hand pressure on the cast in turn controls the intensity of the vibration by varying the spacing between the spring and the core. Impact damage to the cast can be avoided either by providing a flat surface at the top of the anvil against which a flat surface of the cast may be applied to distribute the impact over a substantial area, or by casting a hard anvil-engaging plate into the cast itself. Intense vibration of the cast by the anvil causes an enamel suspension placed on the die surface to be homogeneously compacted. The vibrator spring, mounted closely adjacent the vibrator core, is resiliently biased away from the core so that the intensity of the vibrations may be increased by exerting pressure on the cast so as to push the anvil and spring toward the core, and decreased by relaxing the pressure on the cast.

Referring now to the drawings, in FIG. 1 are shown hands **10** and **12** of a technician holding a cast **14**. A platinum die **16** to be coated with dental porcelain is inserted into the cast **14**. Adjacent cast **14** is a vibrator **18** having an anvil **20** which may have a flat upper surface (FIGS. 2 and 3), and including hand rest and reference areas **22** adjacent anvil **20**. The vibrator **18** as shown in FIGS. 2 and 3 includes a housing, within which are mounted electrical windings **24** adapted to be connected to a conventional electrical outlet (not shown) by electrical leads **26** which pass through an "on-off" switch **28**. In the alternative, a treadle-type remote control switch (not shown) may be substituted for the switch **28**. A magnetic core **30** is excited by the windings **24** at the standard power line frequency of sixty cycles per second. Spaced above the upper surface of the core **30** and adjacent thereto, and held securely in position with respect thereto by generally U-shaped rubber mounting means **32**, is a flat, planar steel spring element **34** upon which rests the lower surface of cylindrical post **36** of anvil **20**. Post **36** is slidably mounted within a bearing sleeve **38** in the housing of the vibrator and includes a peripheral radially outwardly extending lower flange **40**.

Sleeve **38** also includes a radially outwardly extending flange **39** spaced above flange **40** by a compressible, resilient annular element **42** of rubber or the like.

The top surface of anvil **20** may be made substantially flat but with rounded edges, as best shown in FIG. 3, in order that it may contact a substantial area of cast **14**, thereby distributing the vibratory impact forces over this area to prevent splitting of the cast **14** during vibration. The rounded edges of the anvil in this case permit accurate angle control for fine work where splitting of the cast is no problem.

In the alternative, a metal, plastic or other non-brittle element **41** may be cast into the cast in such a manner that it will absorb the impact of the anvil during the coating process.

The cast may be formed of convention plaster-type materials of their equivalent, and is adapted to receive therein metallic tooth base or die elements upon which a porcelain coating or jacket is formed.

To use the novel device to form a porcelain coating or jacket crown on a die or matrix, a cast **14** is formed to receive the die or matrix, e.g. **16**, on which the crown is to be built. Then switch **28** of the vibrator is thrown to actuate the vibrator so as to cause anvil **20** to reciprocate at the rate of sixty cycles per second. The uniform frequency of the vibration produces a consistent condensation for a given composition of the porcelain suspension and a given amount of pressure on the cast. Next, a small amount of a suspension of ceramic particles in a fluid such as water in the form of a droplet is placed on the surface of die **16** as by a spatula **17**. The suspension may comprise any one of a number of well-known dental porcelains which may be obtained from a variety of suppliers. The lower end of cast **14** is then placed firmly against the anvil **20**. At the beginning, the anvil vibrates just slightly since the steel spring **34** is biased to its extreme position away from the core **30**. Upon placing his hands on surfaces **22** to obtain reference and support, the technician then pushes the cast against the anvil with a force just sufficient to increase the intensity of the vibration to the desired level. Since the suspension is very fluid at first, the vibration is initially held to a minimum intensity to avoid uncontrolled spreading and deterioration of the ceramic material. The vibration causes the particles of ceramic material to precipitate and causes the fluid in the suspension to collect on the surface of the suspension. Then the cast is removed from the anvil and the fluid collected on the surface is removed, e.g. by blotting. To obtain a more dense layer, the cast is again placed in contact with anvil **20** and it is now depressed more than the first time to cause a more intense vibration of the cast. It will be understood that as the anvil **20** is depressed greater and greater amounts, its lower surface moves the spring **34** closer and closer to the core **30** to reduce the magnetic gap and cause the vibration to become more intense. Thus, the technician or operator can control the intensity of the vibration accurately by pivoting his hands, utilizing surface area **22** as a reference. Since part of the fluid has already been removed from the suspension during the first vibration period, the suspension now assumes more of a self-supporting characteristic. It thus can be subjected to more severe vibration. During the second and more severe vibratory period, additional fluid collects on the surface. It is removed also. The cast may thereupon be subjected to even more severe vibration and the moisture then again removed. These steps of increasingly intense vibration may be repeated as often as is necessary to obtain the desired density of material.

After the first layer of enamel has been condensed to the desired density, additional suspension is applied to the surface. It also is subjected to slight vibration, and then to increasingly severe vibration as described above. A substantial number of the second layer particles thereby become embedded in the first layer to effectively integrate the layers into a bonded coating; yet the first layer is now hard enough so that it will no longer "run" when the second layer is applied. The same is true of subsequent layers with respect to their adjacent layers. The number of intermittent applications of suspension droplets and thus the number of layers will be determined by the desired ultimate characteristics of the finished jacket crown. An extremely dense and homogeneous porcelain coating is obtained which is easily workable and is subject to very little shrinkage upon firing. The layers of the coating are moreover integrated well with each other and closely espouse the matrix or die surface. After the desired shape and thickness is obtained, the ceramic is fired in a conventional manner to form the desired fused substance of the finished jacket crown.

Various modifications of the invention within the teachings set forth will be obvious to those in the art. Therefore, the invention is not to be limited to the illustrative forms depiced but only by the scope of the appended claim and the reasonable equivalents thereto.

I claim:

In a vibrator adapted to vibrate a cast carrying a jacket crown die to compact a dental porcelain suspension thereon and including a housing and electromagnetic means therein including a magnetic core for causing electromechanical vibration of a vibratory element positioned adjacent said core, the improvement comprising: a configurated anvil positioned adjacent said element and adapted to be vibrated thereby; said anvil having a generally flat upper surface with convexly rounded edges to contact a substantial area of said cast to dissipate the stresses thereon during vibration; and a hand support and reference surface area adjacent to and extending away from said anvil to serve as a reference for an operator's hands holding said cast on said anvil.

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