United States Patent

Cooper

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[54] PRECISION INVESTMENT CASTING APPARATUS

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[21] Appl. No.: 31,948

[52] U.S. Cl. 164/244, 164/35

[51] Int. Cl. B22c 7/02

[58] Field of Search 164/34–36, 25, 164/26, 46, 50, 79, 98, 110, 129, 138, 241, 244, 246, 249, 360, 362, 363, 369, 376, 411; 249/61, 62

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Assistant Examiner—John S. Brown
Attorney—Albert F. Kronman

[57] ABSTRACT

A precision investment casting tree formed of relatively high-melting point plastic material surrounded by a lower melting point wax is built up to support a plurality of small wax patterns. The tree is supported by a base and surrounded by investment material. The plastic members are hollow so that upon a first heating step the wax melts and runs out of the investment material leaving a cavity within the said material. Upon a subsequent heating step at a higher temperature the plastic melts and runs out of the investment material leaving a sprued investment material which will insure high-quality casting.

10 Claims, 11 Drawing Figures

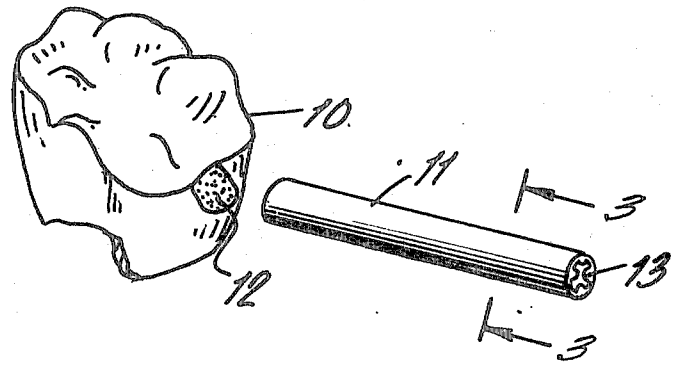


FIG. 1

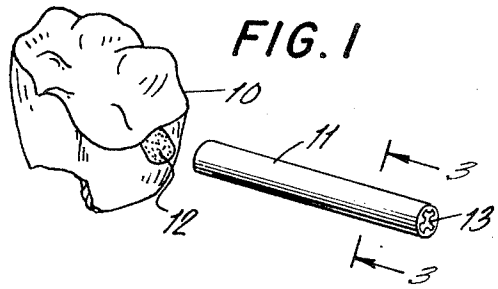


FIG. 2

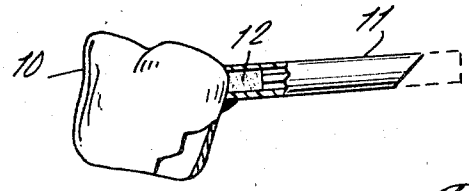


FIG. 3

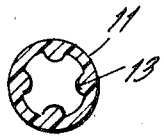


FIG. 6

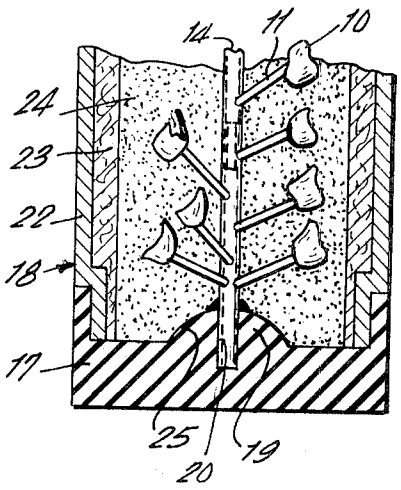


FIG. 7

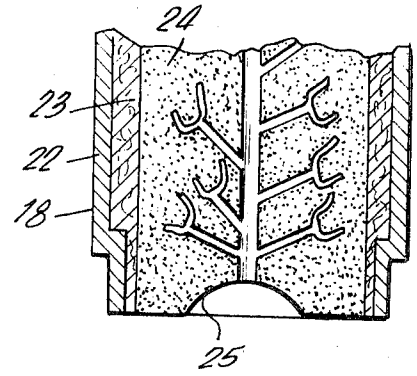


FIG. 4

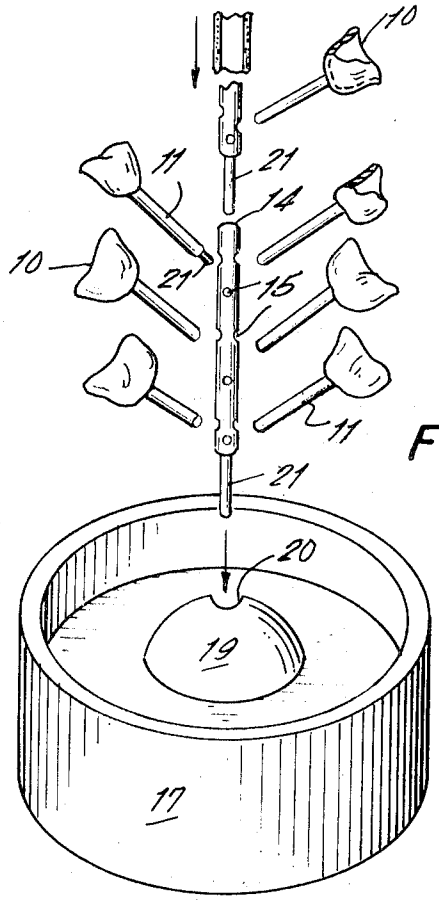


FIG. 8

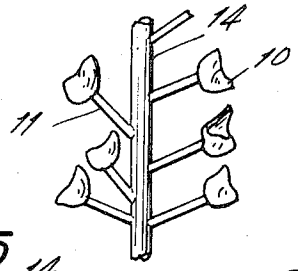
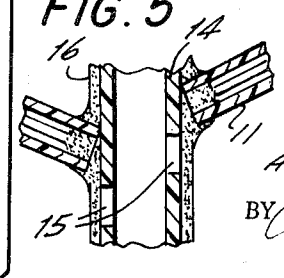


FIG. 5



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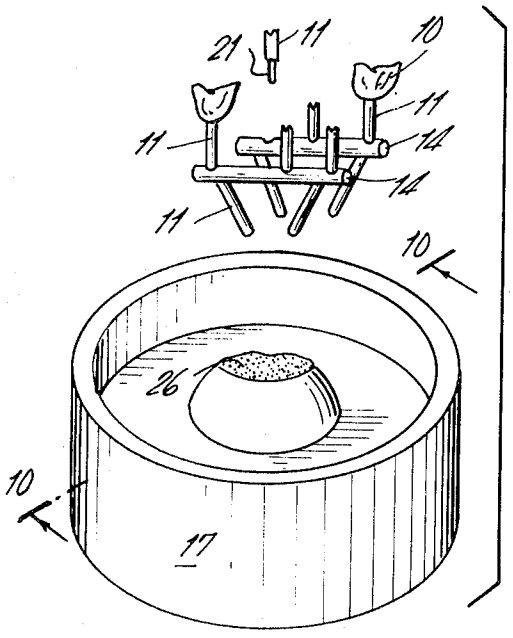

FIG. 9

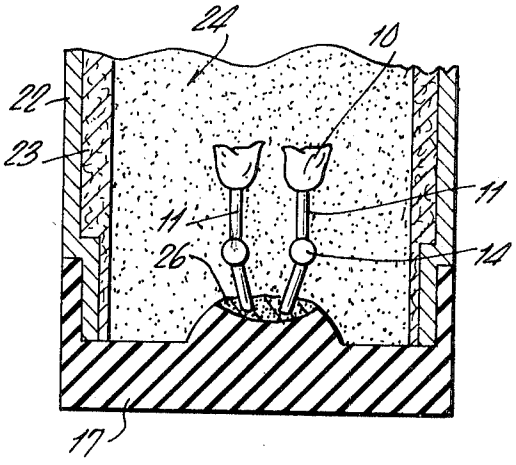

FIG. 10

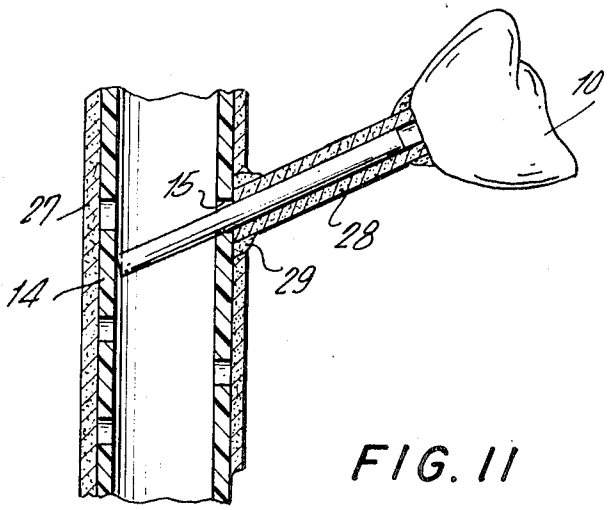

FIG. 11

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PRECISION INVESTMENT CASTING APPARATUS

BACKGROUND OF THE INVENTION

Producing casting by the lost wax method is well known. Where the casting is relatively large little difficulty is encountered because sprue sizes are also large and the material can enter the cavity with ease. Where the casting is small, and the sprue, of necessity also small, problems of turbulence, porosity, water vapor and gases enter into the casting operation.

The present invention relates to the casting of small parts, such as dental restorations, rings, and the like using a tree arrangement for supporting the individual patterns and forming the sprue so that a 100 percent yield can be achieved from each casting operation. The present invention overcomes some of the problems encountered in investment casting of a plurality of small elements such as the reduction of turbulence and porosity by obtaining a completely smooth passage way to receive the metal. Contour and shrinkage changes caused by internal pressures, gases and water vapor developed during removal of the wax pattern so troublesome in the prior art have been overcome.

The following description has been related to the casting of small dental restorations such as crowns and caps. However, it will be apparent that any other small items such as rings, settings, buttons etc. can be substituted for the dental restorations without departing from the present invention.

SUMMARY OF THE INVENTION

This invention relates to a lost wax method casting apparatus in which the individual wax patterns are secured to sprue forming hollow plastic tubes through which wax and moisture can escape from the investment casting material at one temperature. The hollow plastic tubes in turn are thereafter removed from the investment at a much higher temperature. The hollow plastic tubing aids in maintaining structural integrity during drying and curing of the investment material. After the wax and plastic material have been removed by the application of heat, smooth surface passageways and mould cavities remain within the investment material to provide near turbulence-free passages for the metal pour.

DESCRIPTION OF THE DRAWINGS

In the accompanying drawings forming part hereof, like parts have been given identical reference numerals in which drawings:

FIG. 1 is a view in perspective of a tooth crown wax pattern and a hollow ribbed plastic tube before attachment made in accordance with the present invention.

FIG. 2 is a view in side elevation partially broken away of the tooth crown wax pattern of FIG. 1 showing the mode of attachment;

FIG. 3 is a sectional view of a hollow ribbed plastic tube taken on line 3—3 in FIG. 1, somewhat enlarged.

FIG. 4 is a somewhat exploded view of a casting assembly according to the present invention;

FIG. 5 is a fragmentary vertical cross section of another embodiment of a sprue forming casting tree somewhat enlarged;

FIG. 6 is a view in vertical section of the casting flask showing the tree structure and its cluster of wax patterns surrounded by refractory investment material;

FIG. 7 is a view similar to FIG. 6 with the wax patterns and hollow plastic tubes removed by the application of heat;

FIG. 8 is a fragmentary view in side elevation of an assembled tree for insertion in a casting flask base;

FIG. 9 is a somewhat exploded view of a portion of another casting assembly according to the present invention;

FIG. 10 is an assembled fragmentary view in vertical section of the embodiment of FIG. 9;

FIG. 11 is a view in vertical section on an enlarged scale of still another embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, and particularly to FIGS. 1 and 2, 10 indicates a pattern formed of wax, herein illustrated by a crown for dental restoration purposes. A tube 11 formed of hollow tubular plastic material such as polypropylene is secured to the pattern 10 by means of a ball of wax 12. The ball of wax 12 is placed on the wax pattern 10 at a point which will facilitate the entrance of the pouring metal into the cavity. The tube 11 is secured to the wax 12 by applying wax (not shown) to one open end of the tube and pressing it into the ball of wax until the wax cools. The wax will be initially softened by the heated tube and partially drawn up into the tube bore by capillary action as shown in FIG. 2, thereby forming a good mechanical attachment.

It will be seen from an examination of FIG. 3, that the tube 11 is formed with internal ribs 13 which are longitudinally disposed therein. The ribs strengthen the tube 11 and prevent accidental bending thereof during the assembly of the sprue forming tree. A plurality of tubes 11 together with individual patterns 10 attached thereto are carried by a central elongated hollow pin 14 in the present invention. The assembled tubes and pin comprise a sprue forming tree as shown in FIGS. 6 and 8.

The sprue forming tree is assembled in the manner shown in FIG. 4 by inserting the ends of the tubes 11 into holes 15 provided in the wall of the pin 14. Alternately, the construction shown in FIG. 5 may be employed, wherein the pin 14 is covered by a layer of wax 16 to which the tubes 11 are secured by waxing the ends thereof and applying them while warm to the waxed surface.

The tubes 11 are preferably applied to the pin 14 after it has been inserted in the base 17 of a flask 18.

The base 17 is preferably made of some natural or synthetic rubber for reasons hereinafter more fully explained. The base 17 consists of a somewhat cupped-shaped structure with an upwardly extending dome 19 formed in the inside of the cup. The dome 19 is centrally bored as indicated at 20 to receive the end of the pin 14. A short hollow plastic coupling rod 21 may be inserted in the bottom of the pin 14 as shown in FIG. 4 and inserted in the bore 20 to secure the pin to the base 17. The rod 21 may also be used to add additional pins and thereby increase the length and capacity of the sprue forming tree. On larger gage tubes, the hollow rod 21 can be used to connect the tubes 11 to the pin 14 as shown in FIGS. 4 and 9.

With the assembled tree in position on the base 17, an elongated ring 22 forming the outer member of the flask 18 is slipped into the base in the manner shown in FIG. 6. An asbestos liner 23 is positioned within the flask 22 in the well-known manner. Investment material such as phosphate silica investment or any other well-known investment material is poured into the cavity within the liner 23 and around the assembled sprue forming tree as shown in FIG. 6. When the investment material 24 has hardened the base 17 is stripped from the elongated ring 22 thereby providing a metal receiving funnel 25 in the investment material 24.

The assembly may then be heated to approximately 165° F. at which temperature the wax comprising the patterns and other portions of the sprue forming tree, will melt and flow through the elongated bore of the tube 11 and pin 14 to emerge from the investment material 23 at the funnel 25. Because of the low temperature employed smooth walls and passages remain within the investment material. The assembly is then brought up to a temperature of between 350° and 900° F. at which temperatures the plastic material of the tubes 11 and pins 14 will melt and flow out of the investment.

With all of the sprue forming material of the tree and the pattern melted out of the investment material, the molten metal can be poured into the cavity by way of the funnel 25 using centrifugal casting devices such as are well known in the art. The result is a highly satisfactory casting, free of subsurface voids, pores, suckbacks and other casting flaws.

It will be seen from an examination of FIGS. 4 and 8 that a large number of wax patterns may be mounted upon the pin 14 so that many castings may be made simultaneously. In addition, several pins may be employed and a series of pins assembled one upon the other as indicated in FIG. 4. The structure, therefore, lends itself to both savings in labor and gold in the casting operation. In addition, it is within the purview of the present invention to cast patterns of different sizes and to use tubes of a diameter which relate to the size of the specific patterns. Where the pattern is small, it has been found possible to use smaller tubes than have been employed with previously known casting devices. By using plastic tubes 11 instead of waxed pins as has been done previously, the operator can employ small pliers and tools in assembling the tree without breaking or flattening the sprue forming element. Nevertheless, the polypropylene or plastic tubes will melt upon application of sufficient heat and leave a uniform continuous passage for the casting metal.

After the cast metal cools, the investment material and the casting are removed from the ring 22 and individual castings cut from the sprue in the well-known manner. It will be understood that the top of the pin 14 must be sealed off (not shown) before the investment material 24 is poured into the flask.

Where ceramic-gold alloys are used the embodiment shown in FIGS. 9 and 10 is to be preferred. In this form of the invention the pins 14 are disposed horizontally, the patterns are held by upstanding tubes 11 and two or more tubes 11 are used to connect the pins 14 to the base 17. Wax 26 may be placed in the opening 20 of the dome 19 to support the tree until the investment material has hardened. In all other respects the use of this embodiment is the same as that of FIGS. 1–7.

FIG. 11 shows still another modification of the present invention in which the pin 14 is provided with an outer wax sleeve 27. The ends of the tubes 11 are thrust into the holes 15 of the pin 14 after having been covered by similar wax sleeves 28. Heat applied to the ends of the sleeves 28 will provide a satisfactory seal between the wax sleeves 27, 28, as shown at 29 in FIG. 11. The remainder of the structure in this embodiment and the manner of use is the same as in the previously described structures.

From the foregoing it will be seen that there have been provided a sprue forming tree structures which can be completely removed from the investment material without leaving any residue and which will provide smooth, uniform metal receiving walls within the mold cavity. The hollow tree forming elements facilitate the removal of wax, gases, water vapor, and products which are formed during the heating of the investment material.

Having thus fully described the invention, what is claimed as new and desired to be secured by Letters Patents of the United States, is:

1. A precision investment casting tree for use with a flask having a base and an elongated ring to receive investment material and a plurality of small wax patterns comprising a plurality of hollow elongated pattern receiving plastic tubes having a melting point higher than the said wax patterns, means to secure a pattern to one end of each of said tubes, an elongated hollow plastic pin, means to secure the tubes to the pin at their ends opposite the wax patterns and means to secure the pin to the flask base whereby the tree and its patterns are disposed within the flask ring.

2. A device according to claim 1 in which the elongated tubes are formed with internal longitudinally disposed ribs.

3. A device according to claim 1 in which the plastic material has a melting point of the order of 350° to 900° F. and the wax has a melting point of the order of 165° F.

4. A device according to claim 1 in which the pattern securing means is a small quantity of wax carried by the pattern and invading the bore of the tube.

5. A device according to claim 1 in which the elongated tube is formed with a plurality of spaced openings to receive hollow rods carried in the ends of the tubes.

6. A device according to claim 1 in which the pin is covered with a layer of wax and the ends of the tubes are adhered thereto.

7. A device according to claim 6 in which the wax overlies openings in the walls of the tube.

8. A device according to claim 1 in which the tubes and pin are formed of polypropylene.

9. A device according to claim 5 in which the elongated tube is horizontally disposed within the ring and the means to secure the pin to the flask base comprises plastic tubes similar to those supporting the patterns.

10. A device according to claim 5 in which the tubes and the pin are covered with a sleeve of wax.

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