United States Patent

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[72] Inventors **James W. Benfield**
43 Westport Road, Milton, Conn.;
Charles Blechner, 166-25 Powells Cove Blvd., Beechhurst, N.Y.

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[54] **CRUCIBLE FORMER**
4 Claims, 4 Drawing Figs.

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[51] **Int. Cl.** **B22c 7/02**
[50] **Field of Search** 164/34, 35, 36, 45, 237, 238, 244, 249, 376; 249/54

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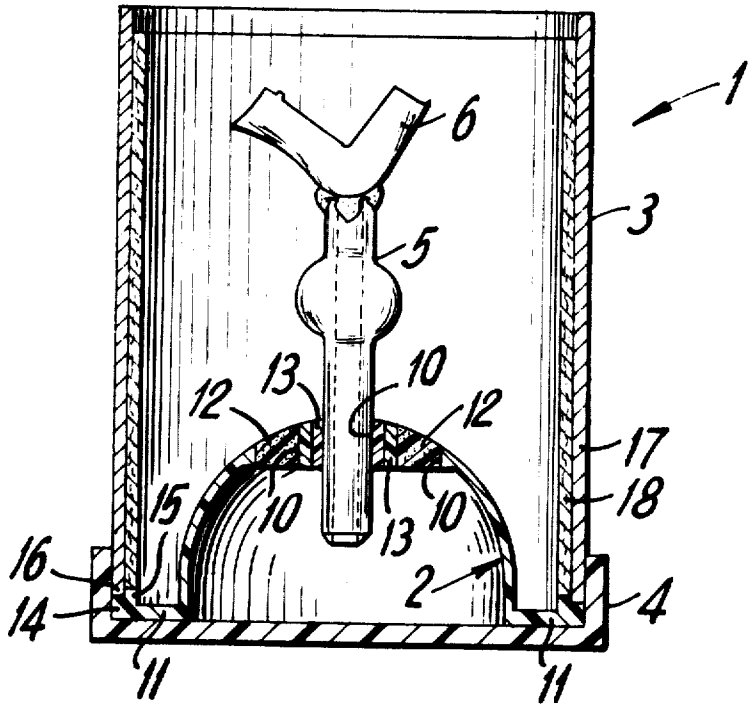
Primary Examiner—J. Spencer Overholser
Assistant Examiner—John E. Roethel
Attorney—Morgan, Finnegan, Durham & Pine

ABSTRACT: A crucible former for use in the production of metal castings by the "lost wax" process, which is formed of a thermoplastic material which volatilizes below the mold temperature for making the casting. A flange extends circumferentially about the bottom of the crucible former and interlocks with the bottom of the casting ring. A plurality of sprue pin apertures located symmetrically about the apex of the crucible former mount the sprue pins by means of a friction fit.



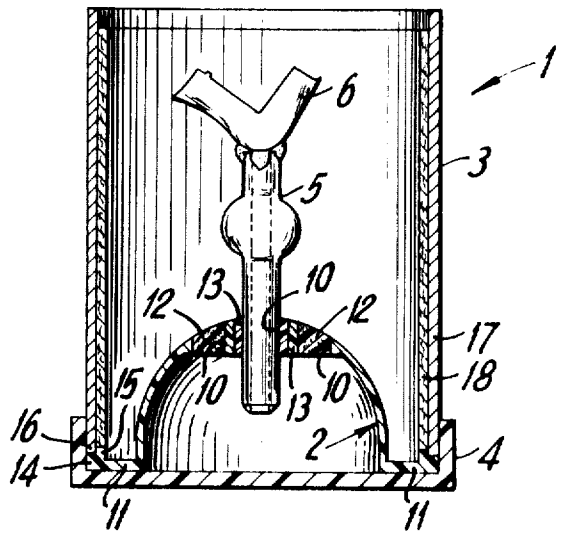


FIG.1

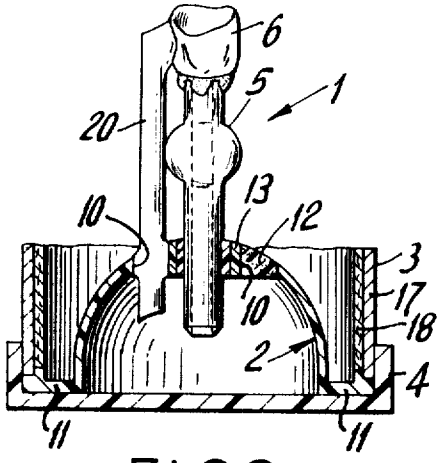


FIG.2

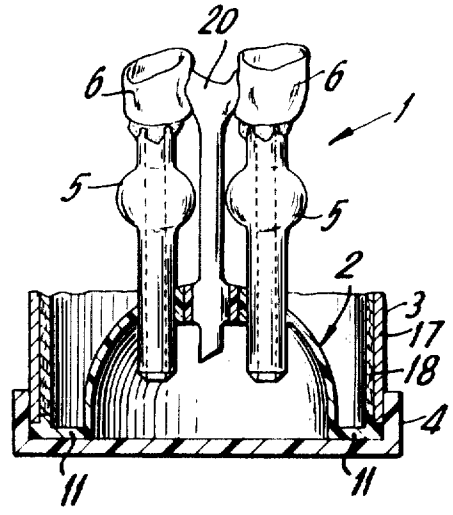


FIG.3

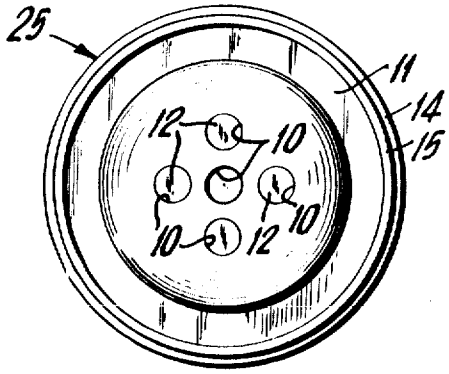


FIG.4

INVENTORS
JAMES W. BENFIELD
CHARLES BLECHNER
BY
Morgan, Finnegan, Durham & Pine
ATTORNEYS

CRUCIBLE FORMER

BACKGROUND AND OBJECTS OF THE INVENTION

The present invention relates generally to the production of metal castings by the "lost wax" process, having utility especially in dentistry for the production of dental castings, and relates more particularly to certain new and useful improvements in the formation in such casting processes of the crucible for receiving the molten metal and directing it through the sprue passageway to the mold cavity.

As is well known to those versed in the art of producing dental castings by the "lost wax" process, it is customary to attach a wax pattern of the casting to one end of a sprue pin, which may be made of metal, plastic or wax, and to insert the other end of the pin into a wax-filled hole in a sprue base or crucible former. A steel ring, usually lined with asbestos, is then placed over the crucible former and the ring is filled with a refractory material, called "investment." When the investment has set, the crucible former is removed and the ring is then placed in an oven to burn out the wax pattern and thus create a mold cavity for the casting. After the ring has been partially heated, in the case where a metal sprue pin is utilized, the pin is removed to permit the wax to escape from the mold cavity.

The openings in the investment mold formed upon the removal therefrom of the crucible former, wax pattern and sprue pin, respectively, are referred to as the "crucible," "mold cavity" and "sprue." The crucible serves as a receptacle for the molten metal, from which it flows through the sprue passageway, the latter serving to feed the metal to the mold cavity. The ring which is placed over the crucible former is referred to as the "casting ring," the product resulting from filling up the mold cavity with metal is the "casting," and the metal stem portion attached to the casting and located in the sprue is called the "metal sprue."

A more detailed description of the customary procedures in producing dental castings, and of a preferred construction of the sprue pin, appears in U.S. Pat. No. 3,340,923, issued Sept. 12, 1967, and the disclosure of that patent is incorporated herein by reference.

It has heretofore been customary in producing dental castings to form the crucible by means of a rubber or metal crucible former, which is removed after the investment has set but prior to placement of the investment and surrounding ring into the oven. It has been found that this practice is disadvantageous for several reasons, but primarily because it results in contamination of the molten metal with particles of the investment material, termed "inclusions," causing porosity in the casting. Porosity, in turn, may make it difficult to bring the casting to a high luster. In the case of dental castings, unless this is done, the patient is likely to have another cavity develop because of food retention in those pores which are at the contact area of an adjacent natural tooth. Porosity in the casting also requires more time on the part of the technician for finishing. He may have to add metal (gold solder) to cover an area of porosity, or he may have to make the casting over again.

Thus, in the case of the rubber crucible formers, the rubber material has a rough surface, and the roughness is likely to increase with use. Any irregularity in the surface of the crucible former is undesirable since it creates corresponding irregularities in the surface of the crucible in the investment, resulting in small particles of the refractory investment material being picked up by the molten metal as it contacts the surface of the crucible and is carried into the mold cavity.

Furthermore, the conventional rubber crucible former has a hole of about one-fourth inch diameter formed therein which is filled with a soft wax plug. Sprue pins, whether they be of a metal, plastic or wax composition, are inserted into this soft wax to hold them in position during the flowing of the refractory investment material into the ring. Even though an attempt is made by the technician to smooth the soft wax around the sprue pins, this area is almost certain to be rough. Since this

area immediately surrounds the point of the crucible where the molten metal enters the sprue hole, it may also contribute to contamination of the molten metal by particles of the investment material and, consequently, to unwanted porosity in the casting.

Another important disadvantage that has been found in the rubber crucible former is that the pores of the rubber become clogged with investment. This means that they must be cleaned between uses. This is time consuming, and unless it is done thoroughly the pieces of investment that remain on the surface of the crucible former will likely become incorporated on the surface of the investment that forms the crucible in the next casting, again leading to contamination of the molten metal.

The crucible formers made of metal are also disadvantageous in that the metal must be noncorrosive since the investment material will soon attack ordinary metals and roughen their surface, with the aforedescribed attendant disadvantages. Also, both metal and rubber crucible formers are disadvantageous since they must be removed from the ring prior to casting and this act of removal often disturbs the surface of the investment, again resulting in unwanted inclusions in the molten metal, and hence, porosity in the casting.

It is therefore an object of this invention to provide a new and improved crucible former, of utility especially in the production of dental castings by the "lost wax" process.

Another object of this invention is to provide a new and improved crucible former which eliminates all of the aforedescribed disadvantages of the crucible former constructions heretofore known in the production of castings, particularly dental castings, by the "lost wax" process.

Another object of this invention is to provide a new and improved crucible former which may be burned out before the mold is heated to the necessary temperature for casting, thereby avoiding any disturbance of the investment, as occurs where the crucible former is physically removed, with the consequent risk of investment particles contaminating the molten metal and causing voids in the casting.

Another object of this invention is to provide a new and improved crucible former which mounts the sprue pins by a friction fit in the sprue pin apertures.

Another object of this invention is to provide a novel thermoplastic crucible former which volatilizes below the mold temperature for making the casting, thereby forming a clean and smooth crucible surface and hence reducing porosity in the casting caused by turbulence and the inclusion of investment particles in the molten metal, and eliminates time-consuming cleaning of the crucible former.

Objects and advantages of the invention are set forth in part herein and in part will be obvious herefrom, or may be learned by practice with the invention, the same being realized and attained by means of the instrumentalities and combinations pointed out in the appended claims.

The invention consists in the novel parts, constructions, arrangements, combinations and improvements herein shown and described.

SUMMARY OF THE INVENTION

It has been found that the objects of this invention may be realized by forming, preferably by molding, the crucible former from a thermoplastic material such as medium density polyethylene, which volatalizes completely at a temperature below the mold temperature used in making the casting. At least one, and as many as five, sprue pin apertures are formed, preferably in symmetrically spaced locations about the apex of the crucible former, of a size so as to receive the sprue pins in a tight friction fit. Advantageously, the base of the crucible former has circumferentially extending flange with a bead on the periphery thereof adapted to interlock with the bottom of the casting ring when assembled therewith.

The crucible former of this invention provides a remarkably clean and smooth surface for the crucible, to the extent that it

has a glassy character. Since the crucible former is burned out instead of being physically removed, there is nothing to roughen or disturb the surface of the investment over which the molten metal flows prior to reaching the mold cavity. The friction fit of the sprue pins in the crucible former apertures eliminates the need for a wax seal at this critical point, which is where the molten metal enters the sprue passageway. Consequently, no investment particles become included in the molten metal and the casting is free from porosity. Since the crucible former volatilizes after a single use, all time-consuming cleaning operations are eliminated, as well as the possibility of investment buildup on the crucible former which would lead to surface irregularities in the crucible.

It will be understood that the foregoing general description and the following detailed description as well are exemplary and explanatory of the invention but are not restrictive thereof. Thus, while the crucible former of the invention is particularly adapted to and was designed for use in the production of dental castings, the principles underlying the invention are not limited to such usage, but are equally applicable, for example, in the manufacture of jewelry or precious metal parts for use in the electronics industry. However, since the invention is particularly adaptable to the production of dental castings, reference is made herein to such usage as an example of a practical and useful embodiment of the invention.

The accompanying drawings, referred to herein and constituting a part hereof, illustrate preferred embodiments of the invention, and together with the description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Of the drawings:

FIG. 1 is a longitudinal sectional view, partly in elevation and partly fragmentary, illustrating a crucible former embodying the present invention in assembled relationship with a casting ring and base member, the view also showing a sprue pin mounted in the crucible former and carrying a wax pattern to be cast in metal;

FIG. 2 is a fragmentary, longitudinal sectional view, partly in elevation, illustrating the crucible former of FIG. 1 having both a sprue pin and an auxiliary wax wire sprue mounted therein;

FIG. 3 is a fragmentary, longitudinal view, partly in elevation, illustrating the crucible former of FIG. 1 having two sprue pins and an auxiliary wax wire sprue mounted therein; and

FIG. 4 is a top plan view of an alternate embodiment of a crucible former constructed in accordance with the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now more particularly to FIGS. 1–3 of the accompanying drawings, there is illustrated a conventional arrangement for a crucible assembly employed in the "lost wax" process for producing dental castings, indicated generally by reference numeral 1, including a preferred embodiment of a crucible former constructed in accordance with the invention, indicated generally by reference numeral 2, a casting ring 3 and a base member 4 maintaining the casting ring and crucible former in assembled relationship. A suitable sprue pin 5 carrying the wax pattern 6 to be cast in metal is mounted in the crucible former 2.

As here preferably embodied, crucible former 2 is formed, preferably by molding, of a thermoplastic material in a substantially hemispherical configuration, having a plurality of sprue pin apertures 10, equispaced along a radially extending line passing through the apex of the hemisphere and a flange 11, extending circumferentially about the base of the hemisphere. In the preferred embodiment, there is provided three sprue pin apertures and the unused apertures are filled with wax plugs, as shown at 12. It should be understood that the hemispherical shape of crucible former 2 is only a preferred configuration, and that other configurations may be used with equally satisfactory results, such as, for example, a truncated cone.

Advantageously, each of the sprue pin apertures 10 includes a boss 13 extending inwardly of the crucible former surface a distance sufficient to support the sprue pins, such as illustrated at 5, therein by means of a friction fit.

Also advantageously, the circumferentially extending flange 11 is provided with a bead 14 on the periphery thereof having a vertically extending flange 15 which interlocks with a corresponding flange 16 formed about the bottom periphery of the casting ring 3 in assembly relationship.

Where the casting ring 3 comprises the conventional steel ring 17 lined with a layer of asbestos 18, as illustrated in the drawings, the flange 16 is advantageously formed at the joint between the crucible former and the steel.

It will be apparent from the foregoing that the interlocking flanges 15,16 serve to insure that the crucible former is firmly held in position when the investment has set and the base is removed prior to the ring and investment being placed in an oven for the burn out operation.

In accordance with the invention, the thermoplastic material used in forming the crucible former 2 is of such nature that the crucible former is sufficiently rigid at room temperature to support the sprue pins therein and the pressures associated with vacuum investing, which are on the order of 29 inches Hg, but volatilizes completely at a temperature below the mold temperature used in making the casting. Advantageously, the thermoplastic material volatilizes at a temperature above that of the material used for the wax pattern. An example of a suitable thermoplastic having the aforementioned properties is medium density polyethylene. While a thermoplastic material is preferred, it will be understood that other equivalent materials may be used, so long as the aforementioned properties are satisfied.

Advantageously, sprue pin 5 is of a construction such as that described in the aforementioned U.S. Pat. No. 3,340,923, in which case both the sprue pin and crucible former are burned out after the wax pattern 6 has melted and the entire passageway to the mold cavity is equally free of surface irregularities.

The operation of the "lost wax" process for producing dental castings utilizing the crucible former of this invention is as follows: At least one sprue pin 5 carrying a wax pattern 6 to be cast in metal is friction fit in aperture 10 and the remaining apertures are filled with wax plugs 12 so as to provide the crucible former with a continuously smooth outer surface. The crucible former flange 11 is then interlocked with the casting ring 3, whereupon the latter is fitted in base member 4 to form the crucible assembly, the base 4 also providing a seal for vacuum investing of the refractory material in the casting ring.

After the casting ring has been filled with the investment material and the investment has set, the base member 4 is removed and the casting ring 3 is placed in an oven to burn out the wax pattern 6 and thus create a mold cavity in the investment. If the sprue pin 5 is metal, after the casting ring has been partially heated, the pin is removed to permit the wax to escape from the mold. If the sprue pin 5 is formed of a hollow, thermoplastic material, as described in the aforementioned U.S. Pat. No. 3,340,923, it is burned out, along with the crucible former 2, after the wax pattern 6 has been eliminated from the mold but before the temperature necessary for casting is reached.

Referring now more particularly to FIGS. 2 and 3 of the accompanying drawings, there is illustrated in FIG. 2 the crucible assembly 1 of FIG. 1, wherein the crucible former 2 carries a sprue pin 5 and an auxiliary wax wire sprue 20 in two of the apertures 10, the remaining aperture being filled with a wax plug 12, while in FIG. 3 there is illustrated the mounting of two sprue pins 5 with the single auxiliary wax sprue 20 therebetween in the sprue pin apertures 10 of crucible former 2. These mounting arrangements are particularly ad-

vantageous where a large cavity is to be cast, as in FIG. 2, or where two smaller cavities are to be cast at the same time, as in FIG. 3, or where there are thin sections in the pattern. Thus, the auxiliary wax sprue pin 20 serves to create an additional passageway for feeding the molten metal to the mold cavity, or cavities, at a sufficient rate to prevent or minimize shrinkage porosity from developing in the casting.

Referring now more particularly to FIG. 4 of the accompanying drawings, there is illustrated an alternate embodiment of the crucible former of the invention, indicated generally by reference numeral 25, which is modified from the crucible former of FIGS. 1–3 to the extent that five sprue pin apertures 10 are symmetrically spaced about the apex of the crucible former. It will be apparent that this modification permits even greater flexibility in the number of castings that can be produced in one operation.

The invention in its broader aspects is not limited to the specific embodiments herein shown and described but departures may be made therefrom within the scope of the accompanying claims, without departing from the principles of the invention and without sacrificing its chief advantages.

What is claimed is:

1. In a crucible assembly for containing investment material in the production of castings by the lost wax process, including a casting ring friction fitted with a base and surrounding a crucible former on which is mounted a sprue pin carrying a wax pattern of the casting, the improvement therein which comprises:

said sprue pin is hollow;

said crucible former includes a thin-walled surface extending into said crucible assembly within said casting ring so as to define a hollow chamber with said base;

said thin-walled crucible former surface includes at least one sprue pin aperture for mounting said hollow sprue pin therein with a friction fit,

said sprue pin aperture including a boss member extending into said defined hollow chamber for providing additional mounting support for the sprue pin frictionally fitted therein;

said crucible former and said sprue pin are formed of a material which is substantially rigid at room temperature and which volatilizes completely at a temperature above that at which said wax pattern melts but below that to which the crucible assembly is heated in making said casting,

whereby upon heating said crucible assembly for casting, said wax pattern escapes therefrom immediately upon melting and thereafter said sprue pin and said crucible former volatilize.

2. A crucible assembly as defined in claim 1, wherein

said crucible former includes a plurality of sprue pin apertures;

at least one sprue pin carrying a wax pattern is mounted in one of said apertures;

an auxiliary wax sprue pin is mounted in an aperture adjacent to the aperture in which said sprue pin carrying a wax pattern is mounted, and extends into contact with said wax pattern; and

the remaining apertures of said plurality of sprue pin apertures are filled with wax plugs.

3. A crucible assembly as defined in claim 1, wherein said crucible former and said sprue pin carrying a wax pattern are formed of a thermoplastic material.

4. A crucible assembly as defined in claim 3, wherein said thermoplastic material is medium density polyethylene.