



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification<sup>4</sup> : A61C 9/00, B29C 33/40</p>	<p>A1</p>	<p>(11) International Publication Number: WO 86/ 00215 (43) International Publication Date: 16 January 1986 (16.01.86)</p>
<p>(21) International Application Number: PCT/US85/01221 (22) International Filing Date: 24 June 1985 (24.06.85) (31) Priority Application Number: 625,112 (32) Priority Date: 27 June 1984 (27.06.84) (33) Priority Country: US  (71)(72) Applicant and Inventor: BERGER, Robert, P. [US/US]; 4421 Rochelle Place, Encino, CA 91316 (US). (74) Agents: BERG, Richard, P. et al.; Ladas &amp; Parry, 3600 Wilshire Boulevard, Los Angeles, CA 90010 (US).  (81) Designated States: AT (European patent), BE (European patent), CH, CH (European patent), DE, DE (European patent), FR (European patent), GB, GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent).</p>		<p>Published With international search report.</p>
<p>(54) Title: PROSTHESIS RESTORATION MOLDING APPARATUS</p>		
<p>(57) Abstract</p> <p>A wax master sprue and gate form used in the investment casting process of dental prosthesis. It has a web (32) between the gates (26, 28, 30) so that the gates are secured together to prevent shifting of the gates during the molding of the casting material around a wax master (52).</p>		

**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	GA	Gabon	MR	Mauritania
AU	Australia	GB	United Kingdom	MW	Malawi
BB	Barbados	HU	Hungary	NL	Netherlands
BE	Belgium	IT	Italy	NO	Norway
BG	Bulgaria	JP	Japan	RO	Romania
BR	Brazil	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	LI	Liechtenstein	SN	Senegal
CH	Switzerland	LK	Sri Lanka	SU	Soviet Union
CM	Cameroon	LU	Luxembourg	TD	Chad
DE	Germany, Federal Republic of	MC	Monaco	TG	Togo
DK	Denmark	MG	Madagascar	US	United States of America
FI	Finland	ML	Mali		
FR	France				

## PROSTHESIS RESTORATION MOLDING APPARATUS

1

BACKGROUND OF THE INVENTION

This invention is directed to a dental prosthesis restoration molding apparatus wherein the gates of the wax master have a web therebetween to retain the gates in place  
5 during the forming of the mold.

The lost wax molding process has been used for centuries in the investment casting of jewelry. It comprises the formation of a wax master in the configuration of the  
10 desired final metal part, attachment of wax sprue and gates to that wax master, casting investment material around the wax master, melting out the wax master, and finally pouring metal into the space previously formed in the investment material molding compound by the wax master. When the  
15 metal of the final object is hardened, the molding compound is broken away, the sprue and gates cut away, and the object is then finished as desired.

The lost wax investment casting molding process  
20 has been employed to mold dental prostheses and restorations, such as metal crowns and portions of bridges. The metals used in dentistry shrink approximately 2 percent upon solidification. Common alloys used for this purpose include nickel-chromium, palladium-gold and palladium-silver.  
25 Depending upon the alloy, these metallic alloys are poured into the investment at temperatures from 1350 to 1650 degrees Fahrenheit. These alloys generally shrink about 2 percent upon solidification. In order to accommodate this metallic



-2-

1 shrinking upon solidification, the investment casting  
materials for dentistry are compounded so that they expand  
the cavity around the wax master by about 2 percent during  
the setting of the investment material. In the molding of  
5 dental prostheses which span several existing teeth, the  
size and shape of the finished molding must be accurately  
maintained.

The investment casting material is a high  
10 temperature ceramic material which is poured in liquid  
form around the wax master. The investment casting material  
goes through a plastic stage during its curing. During  
this plastic stage, the investment material is weak and may  
crack if improper stresses are placed thereon. The geometry  
15 of the wax master is important to permit setting of the  
investment casting material without distortion and cracks.  
The geometry of the sprues and gates of the prior art has  
led to distortion so that it has been difficult to maintain  
accuracy, using present-day wax molding masters.

20

The investment casting processes used for molding  
items with other purposes have employed other techniques  
for avoiding problems during the setting of the investment  
casting material. These other techniques are used in such  
25 manufacturing as the investment casting of jewelry. In  
such cases, an investment casting material having the  
property of not expanding (maintaining the cavity size) is used.  
This prevents cracking of the investment material during

-3-

setting. To accommodate for the shrinking of the metal upon hardening, an oversized wax master is used. This cannot be done in dentistry because the wax master is derived from the actual tooth contour, spacing and arch in the patient's dentition and thus the resulting prosthesis would not properly fit the mouth. Thus, it is necessary to improve the accuracy of present-day wax molding masters to improve the accuracy of the finished dental prostheses molded in conjunction therewith.

#### SUMMARY OF THE INVENTION

Briefly, and in general terms, the invention provides a prosthesis restoration molding apparatus which includes at least two gates connected to each other and spaced from each other and a web connected to the gates to close all openings between the gates.

-4-

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The present invention, both as to its organization and manner of operation, together with further objects and advantages thereof, may be best understood by reference to the following description, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is an isometric view of the prior art wax master sprue and gate structure for use in the lost wax molding process.

-5-

1           FIGURE 2 is an isometric view of the wax master sprue and gate in accordance with this invention, for use in the lost wax molding process, showing a wax master of a dental prosthesis in dotted lines attached thereto.

5           FIGURE 3 is a section of the wax master sprue and gate of this invention, as seen generally along the line 3-3 of FIGURE 2.

10          FIGURE 4 is an exploded view of the wax master sprue and gate and dental prosthesis as they are placed in a mold housing for the placement of mold-forming material therearound.

15          FIGURE 5 is an exploded view showing the mold with the wax still in place, and parts broken away and parts taken in section to show the manner in which the wax master controls the formation of a mold cavity within the molding material.

20          FIGURE 6 is a section taken generally along the line 6-6 of FIGURE 5.

25          FIGURE 7 is a section through the mold, showing the cavity therein after the wax has been melted out, ready for the pouring in of the metal.

-6-

1           FIGURE 8 is a section taken generally along the  
line 8-8 of FIGURE 7.

DESCRIPTION OF THE PREFERRED EMBODIMENT

5           The wax master sprue and gate of the prosthesis  
restoration molding apparatus of this invention is generally  
indicated at 10 in FIGURES 2, 3, 4, 5 and 6. The wax master  
sprue and gate 10 has a sprue structure 12 which has wings  
10 14 and 16 which fit in slots 18 and 20 within boss 24 in  
cap 22. The sprue structure 12 fits within boss 24 to  
form a generally conical exterior structure which will  
serve as a funnel-like sprue in the molding material.

15           Attached to sprue structure 12 are divergent  
gates 26 and 28. Cross gate 30 is secured to the top of  
the divergent gates 26 and 28. The divergent gates and  
cross gate surround a triangular center area. Web 32  
extends across this area and joins gates 26, 28 and 30  
20 over their entire length so as to completely close off the  
area between the gates which would be open in the absence  
of the web. As is seen in FIGURE 3, web 32 is of lesser  
thickness than the gates, about one-quarter the thickness  
thereof. The gates are in the form of circular solid  
25 cylinders, and the web is defined by planes which are  
parallel to each other, spaced from each other, and lie on  
opposite sides of the center axes of all three gates. In  
the present instance, three gates are shown, but in the



-7-

1 more broad sense if there are more than two divergent  
gates, a web is positioned in the opening between adjacent  
gates. Web 32 prevents continuity of the investment material  
between the gates through what would otherwise be an opening  
5 and serves to strengthen the gates and close off any open  
communication inbetween the gates.

The prior art wax master 40, shown in FIGURE 1,  
has a similar sprue and gate structure, but lacks the web  
10 32 in accordance with this invention. Sprue 42 carries  
gates 44 and 46. At the outer end of each of these gates  
and secured thereto is transverse gate 48. Opening 50 is  
provided inbetween the gates. When the prior art wax master  
40 is employed, the investment casting material extends  
15 through opening 50. This investment casting material grasps  
around the gates and provides a solid area between the  
gates. This solid area shrinks during setting and causes  
stresses on the gates which causes cracking of the investment  
casting material and distortion of the gates.

20

Upon the wax master sprue and gate structure 10  
is mounted a wax master prosthesis 52. The prosthesis  
carries a plurality of parts, each generally representing a  
tooth restoration or tooth prosthesis. Each of the parts  
25 of the prosthesis is connected to the cross gate 30, and  
the parts of the wax master prosthesis may be connected  
together, as is well seen in FIGURE 5. All connection and  
touchup for size, shape and positioning are done in wax at  
this time.

-8-

1           After the wax master prosthesis is put into  
satisfactory condition, mold housing 54 is placed into the  
cap. Mold housing 54 has a liner 56 therein. The mold  
housing is preferably of metal, and the liner is of softer  
5 material such as siliceous or rock wool fiber paper.  
With cap 22 on the bottom, mold housing 54 surrounds and is  
spaced from the wax master prosthesis as well as the wax  
master sprue and gate. Thereupon, the investment casting  
molding compound 58 is placed in the mold. It is runs  
10 down around the wax master sprue, gate and prosthesis, and  
is hardened in that position.

The molding material is a high temperature ceramic,  
and while the apparatus of this invention is useful with  
15 the usual types of lost wax investment material, it is  
particularly useful with modern high temperature ceramic  
investment material used in dental investment casting such  
as crystobelite. The powder is mixed with a liquid and  
poured into the mold around the wax master structure. It  
20 hardens in the mold without heat and during the hardening  
process, it goes through a plastic stage. In reaching the  
plastic stage, the investment material shrinks and when it  
can engage all the way around the gates, the shrinkage  
applies radial and other forces to the gates which cause  
25 movement in the position and shape of the prosthesis. The  
web 32 helps hold the gates and consequently the prosthesis  
wax master in place during this hardening stage. Holding  
the gates in place is particularly necessary where the

-9-

1 prosthesis includes caps on the ends of a bridge, such  
as is shown in the prosthesis 52. The end caps must be  
accurately placed and the arch must be of the proper shape  
for the prosthesis to properly fit in the mouth.

5

It is to be noted that the dental investment  
casting molding compound 58 does not enter through an  
opening between the gates. In the prior art, when the  
molding compound went through the opening 50 between the  
10 gates, the molding compound during its hardening process  
caused distortion of the gates which caused movement of  
transverse gate 48 and the wax master prosthesis mounted  
thereon. The result was changes in configuration between  
the original wax master prosthesis and the mold cavity  
15 derived therefrom. The forces of the molding compound on  
the wax master gates cause this repositioning of the parts  
of the prosthesis. The placement of the web 32 so that it  
completely prevents the molding compound from closing  
around the divergent gates and cross gates prevents this  
20 source of distortion. In addition, the web 32 provides  
lateral strength in the direction of the gates toward and  
away from each other, rather than present a situation of  
unsupported gates 44, 46 and 48. By the use of the web 32  
connecting to the adjacent gates and completely prevently  
25 any through engagement of the molding compound provides  
the positioning strength.

-10-

1           After the molding compound is set, cap 22 is  
removed from the full line to the dotted line position of  
FIGURE 5, and the mold housing 54 with its contents is  
turned over. Thereupon, the entire structure is heated so  
5 that the wax melts out. After the wax is melted out, there  
is a cavity 60 into which the metal of the prosthesis  
structure will be poured. The sprue at the top provides a  
funnel-like structure to receive the hot metal. As seen in  
FIGURES 7 and 8, the cavity 60 includes a flat cavity  
10 section 62 into which a metallic web is cast with the rest  
of the casting process. The cavity includes the prosthesis  
molding section at the lower portion of FIGURE 7, and this  
prosthesis section has been held accurately in place during  
the formation of the mold cavity during the formation of  
15 the cavity. Accordingly, the prosthesis is accurately  
positioned.

After the metal is poured into the mold and is  
cooled, the molding compound is thrust axially out of the  
20 mold housing. The mold liner 56 provides the freedom for  
ease of removal of the molding compound with the metal  
therein. When removed, the molding compound is broken away  
from the metal prosthesis and gates. The prosthesis is  
further finished by cutting away the gates, final shaping,  
25 ceramic coating and sintering, or whatever conventional  
prosthesis making requires. Thus, an accurate prosthesis  
is produced.

-11-

1           This invention has been described in its  
presently contemplated best mode, and it is clear that  
it is susceptible to numerous modifications, modes and  
embodiments within the ability of those skilled in the  
5 art and without the exercise of the inventive faculty.  
Accordingly, the scope of this invention is defined by  
the scope of the following claims.

-12-

WHAT IS CLAIMED IS:

1. A prosthesis restoration molding apparatus comprising at least two gates connected to each other and spaced from each other; and

a web connected to said gates to close all openings between said gates.

2. The prosthesis restoration molding apparatus of Claim 1 wherein said web has a lesser thickness than said gates.

3. The prosthesis restoration molding apparatus of Claim 2 wherein said web is less than half the thickness of said gates.

4. The prosthesis restoration molding apparatus of Claims 1, 2 or 3, wherein said at least two gates are first and second divergent gates connected to each other and connected to a sprue at their adjacent ends, and there is a third gate connected between said first and second gates adjacent their divergent ends, said web being attached to all three of said gates to close all openings between said gates to hold said third gate and any prosthesis attached thereto in place during the placement of molding compound therearound.

5. The prosthesis restoration molding apparatus of Claim 4 wherein said gates and said web are made of wax to serve as a wax master gate structure in the lost wax molding process, and, wherein a wax master of a

-13-

dental prosthesis is mounted on said third gate.

6. The prosthesis restoration molding apparatus of Claim 1 wherein said gates are of circular cross section and said web is positioned to prevent the molding material from wrapping around said gates to preclude substantial forces on said gates from said molding material.

7. The prosthesis restoration molding apparatus of Claim 1 wherein said gates are of substantially the same diameter and are of substantially uniform diameter and said web is less than about half the diameter of said gates.

FIG. 1  
PRIOR ART

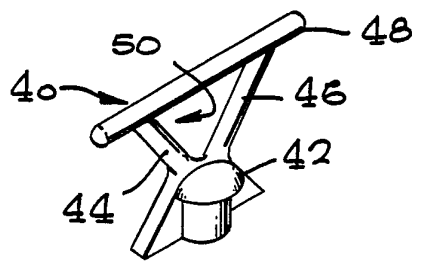


FIG. 2

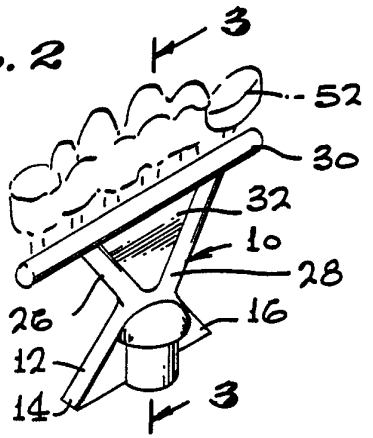


FIG. 9

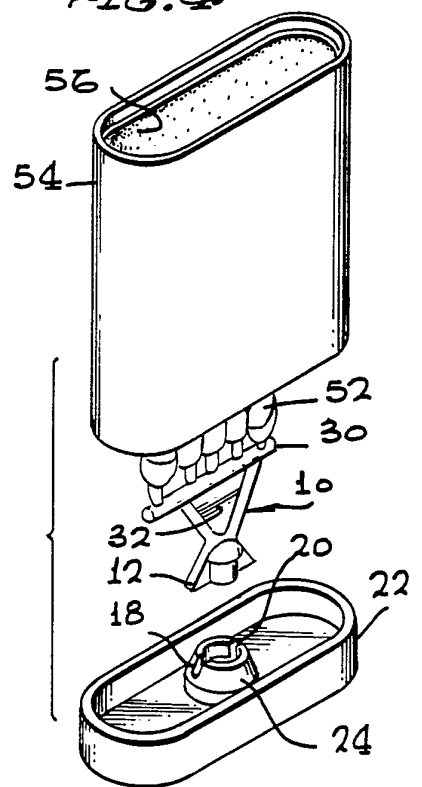


FIG. 5

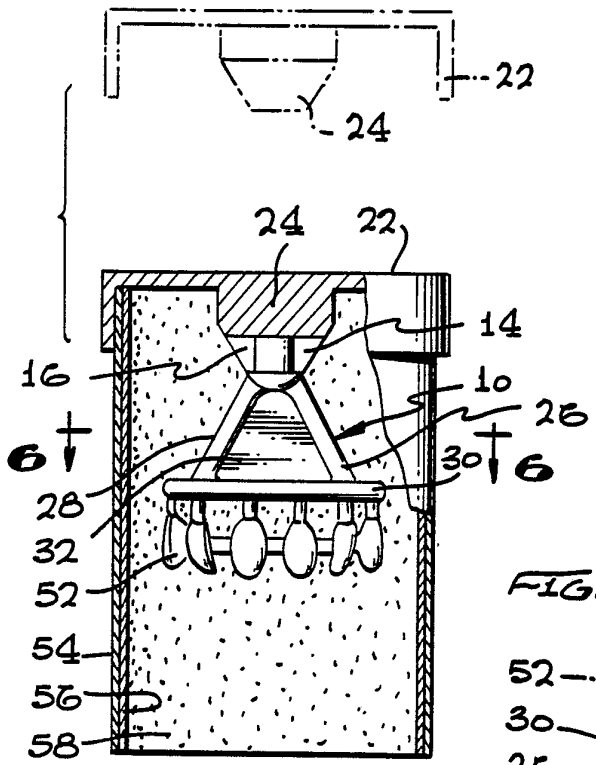


FIG. 3

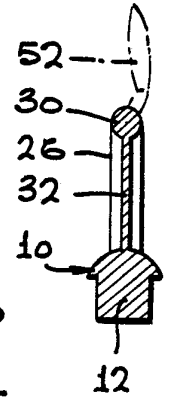


FIG. 7

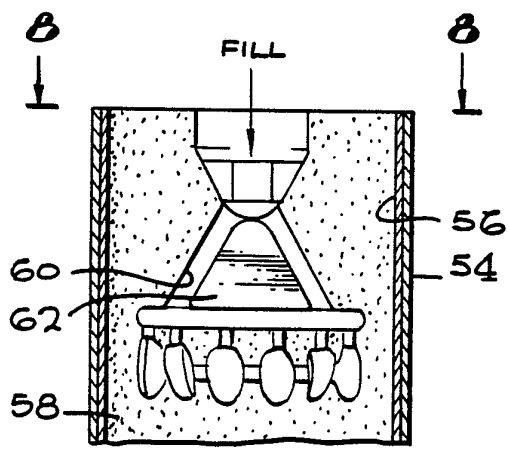


FIG. 8

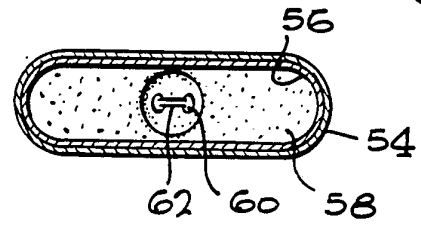
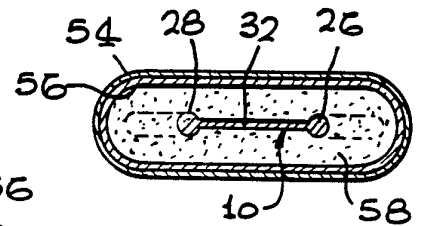


FIG. 6





# INTERNATIONAL SEARCH REPORT

International Application No PCT/US85/01221

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>3</sup>		
According to International Patent Classification (IPC) or to both National Classification and IPC		
U.S. CL. 249/62; 164/246		
INT. CL. 4 A61C 9/00 B 29C 33/40		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>4</sup>		
Classification System	Classification Symbols	
US	249/54, 61,62,175 164/DIG.4,246 264/221	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>5</sup>		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT</b> <sup>14</sup>		
Category <sup>*</sup>	Citation of Document, <sup>16</sup> with indication, where appropriate, of the relevant passages <sup>17</sup>	Relevant to Claim No. <sup>18</sup>
X	U.S.A 3,985,178 PUBLISHED 12 OCTOBER 1976, SEE FIG. 5 and 6, COOPER.	1-7
A	U.S.A 1,244,257 PUBLISHED 23 OCTOBER 1917, SWEETNAM.	
A	USA 1,307,299 PUBLISHED 17 JUNE 1919, LAING.	
A	U.S.A 2,065,977 PUBLISHED 29 DECEMBER 1936, JEFFRIES.	
A	U.S.A 3,192,583 PUBLISHED 6 JULY 1965, FAYREAR.	
A	U.S.A 4,081,019 PUBLISHED 28 MARCH 1978, KULIG.	
A	U.S.A 4,246,954 PUBLISHED 27 JANUARY 1981, COHEN ET AL.	
<p><sup>*</sup> Special categories of cited documents: <sup>15</sup></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&amp;" document member of the same patent family</p>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search <sup>3</sup>	Date of Mailing of this International Search Report <sup>3</sup>	
5 AUGUST 1985	28 AUG 1985	
International Searching Authority <sup>1</sup>	Signature of Authorized Officer <sup>20</sup>	
RO/US	W.E. HOAG	