HEATED BLADES FOR WAX MELTING

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ABSTRACT

A wax tree assembly heating system for heating wax on the surface of a wax component is provided. The system includes an elongated bar of heat conducting material, having a heating surface, and a heating element for heating the heating surface. The heating surface is configured to contact a wax component, such as a wax runner or a gate of a wax pattern, and has a space for retaining molten wax when the heating surface contacts a surface of the wax component. In another embodiment, the wax tree assembly heating system has a plurality of raised heating surfaces that are configured for producing molten wax on a plurality of areas on one or more surfaces of at least one wax component. Additionally, an electrical circuit is provided which includes a heating element and a temperature controller to control the temperature at which wax is melted.
AC POWER

SINGLE LOOP TEMPERATURE SENSOR

TEMPERATURE SENSOR

SOLID STATE RELAY

HOT KNIFE

FIG. 11
HEATED BLADES FOR WAX MELTING
CROSS-REFERENCE TO RELATED APPLICATIONS


BACKGROUND OF THE INVENTION

[0002] 1. Technical Field

[0003] This invention relates to the production of wax trees for casting and, more particularly, to blades or knives for heating the surfaces of wax runners and wax pattern gates in a process for attaching a wax pattern gate to a wax runner.

[0004] 2. Background Information

[0005] The Lost Wax Process is a long established process for casting. In the practice of the Lost Wax Process a wax pattern of a part to be cast is molded in wax. When the wax pattern is molded, a pattern gate is molded with the wax pattern in one piece. Wax runners are also molded separately. Wax runners are usually at least one branch, frequently with flat surfaces and two ends. Some wax runners have circular cross sections and, thus, do not have either flat surfaces or edges. At one end of the runners, there is a head, and, at the other end, there is a tail. A pour cup may be located at the head. The wax pattern gates are affixed to the wax runners to form a wax tree. To do this, both the attaching surface of the wax pattern gate and the surface of the wax runner need to be heated sufficiently to melt wax to permit fusion. Once the wax patterns are affixed to the wax runner, a wax tree has been formed, and then ceramic material is placed on the wax tree. Once the ceramic has hardened, it is heated causing the wax to flow out of the ceramic. The ceramic thus forms a mold into which the molten metal is poured to produce the desired part.

[0006] In recent times, much of the Lost Wax Art has been substantially automated. In the patent application of Ludwig, et al, entitled Process and Apparatus for the Assembly of Wax Trees, U.S. patent application Ser. No. 10/304,840, now U.S. Pat. No. 6,910,519, assigned to the same assignee, an advanced process and apparatus is taught for automating the fusion of wax gates of wax patterns to a wax runner. A heated blade is used to heat the pattern gates and the wax runner. The heated blade, the heated gate and the wax runner are all manipulated by robotics. However, the fusion of wax pattern gates to a wax runner has been traditionally a manual operation performed by heating putty knives on a Bunsen Burner to melt the surface of the wax runner and the end of the pattern gate.

[0007] In the automated process, the wax runners are held by a head stock and a tail stock in a runner station. The wax runner is also heated in the automated process so that a plurality of wax patterns can be affixed to the wax runner at one time.

[0008] Maintaining a wax runner in a perfectly flat position when attaching the wax patterns is a most desirable goal, but unfortunately is not readily attainable. As a result, portions of the wax runner are penetrated more deeply by the heated blade than other portions. Excess molten wax is a result of excessive melting, and, should the excessive melted wax run over the side of the wax runner, the wax runner and the wax patterns attached to it are not useable, resulting in lost product.

[0009] In heating the wax gate and the wax runner, the temperatures of heating the wax can become sufficiently high as to exceed the flash point of the wax causing it to give off fumes which are considered to be a health hazard.

[0010] Therefore, it is highly advantageous to provide a blade for heating a wax runner that prevents molten wax from running over the edge of the wax runner, and it is also highly desirable to control the temperature of the heated blade for melting wax on the wax pattern gate and wax runner to avoid the emission of fumes.

SUMMARY OF THE INVENTION

[0011] The present invention provides, in a first aspect, a wax tree assembly heating system for heating a wax surface. The system comprises an elongated bar of heat conducting material having a heating surface and means for heating the heating surface. The heating surface is configured to contact at least one of a pattern gate and a wax runner, and the heating surface has a space for molten wax to be retained when the heating surface contacts a wax surface of at least one of the pattern gate and the wax runner.

[0012] In a second aspect in accordance with another embodiment, the present invention provides a wax tree assembly heating system for producing molten wax on a plurality of areas on one or more surfaces of at least one wax component. The system comprises the following features: an elongated bar of heat conducting material having a plurality of raised heating surfaces configured to contact at least one of a pattern gate and a wax runner; and means for heating the raised heating surfaces.

[0013] The present invention provides, in a third aspect, a method of heating wax on a surface of a wax component using a wax tree assembly heating system having a heating surface in preparation for fusing the wax component to another wax component in assembling a wax tree. The method comprises providing an elongated bar having a heating surface configured to provide a space for molten wax to be retained when the heating surface contacts a wax component, heating the heating surface, and temporarily positioning the heating surface of the elongated bar in contact with the wax component.

[0014] These, and other objects, features and advantages of this invention will become apparent from the following detailed description of the various aspects of the invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. 1 is a side elevation showing wax patterns with pattern gates being held in a fixture on one side of a knife with a wax runner on the opposite side of the knife, with the knife including conformal contact areas.

[0016] FIG. 2 is a plan view of the base of a knife having an elongated groove pattern.
[0017] FIG. 3 is a cross-sectional view along lines 3-3 of FIG. 2.

[0018] FIG. 4 is a plan view similar to FIG. 2 but with a concave pattern.

[0019] FIG. 5 is a cross-sectional view along lines 5-5 of FIG. 4.

[0020] FIG. 6 is a plan view of the base of a knife having conformal heating surfaces.

[0021] FIG. 7 is a cross-sectional view along lines 7-7 FIG. 6.

[0022] FIG. 8 is a plan view of the base of a knife having conformal heating surfaces with grooves in the surfaces.

[0023] FIG. 9 is a cross-sectional view along lines 9-9 of FIG. 8.

[0024] FIG. 10 is a cross-sectional view of the knife shown in FIG. 1 showing the heating element and a temperature sensor in the blade.

[0025] FIG. 11 is a circuit diagram for controlling the heating of the knife.

[0026] Table 1 below provides a list of reference numbers found in the accompanying drawings.

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Wax Pattern</td>
</tr>
<tr>
<td>13</td>
<td>Wax Runner</td>
</tr>
<tr>
<td>14</td>
<td>Wax Pattern Gate</td>
</tr>
<tr>
<td>15</td>
<td>Pattern Holder</td>
</tr>
<tr>
<td>17</td>
<td>Pour Cap</td>
</tr>
<tr>
<td>19</td>
<td>Head</td>
</tr>
<tr>
<td>21</td>
<td>Knife</td>
</tr>
<tr>
<td>22</td>
<td>Surface (Contact Runner)</td>
</tr>
<tr>
<td>23</td>
<td>Surface (Contact Gate)</td>
</tr>
<tr>
<td>27</td>
<td>V-shaped Groove</td>
</tr>
<tr>
<td>29</td>
<td>Edge</td>
</tr>
<tr>
<td>31</td>
<td>Conformal Surface</td>
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<tr>
<td>33</td>
<td>Sides</td>
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<tr>
<td>35</td>
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<tr>
<td>36</td>
<td>Grooves</td>
</tr>
<tr>
<td>37</td>
<td>Base Surface</td>
</tr>
<tr>
<td>39</td>
<td>Heating Element</td>
</tr>
<tr>
<td>41</td>
<td>Temperature Sensor</td>
</tr>
<tr>
<td>43</td>
<td>A-C Power Supply</td>
</tr>
<tr>
<td>45</td>
<td>Circuit Breaker</td>
</tr>
<tr>
<td>47</td>
<td>Temperature Controller</td>
</tr>
<tr>
<td>51</td>
<td>Solid State Relay</td>
</tr>
<tr>
<td>53</td>
<td>Solid State Contact</td>
</tr>
</tbody>
</table>

DETAILED DESCRIPTION OF THE INVENTION

[0027] Referring now to FIG. 1, the general relationship is shown between wax patterns 11 and a wax runner 13. The wax patterns include wax patterns gates 14. The wax patterns 11 are held by a pattern holder 15. The wax runner 13 with a pour cup 17 at the head 19 is located beneath the wax patterns 11. A knife 21 having conformal surfaces in accordance with this invention, as will be hereinafter explained, is located between the wax patterns 11 and the wax runner 13. After both the wax pattern gates 14 of the wax patterns 11 and the wax runner 13 are heated by the knife 21, which is temporarily interposed between the wax patterns 11 and the wax runner 13, the knife 21 is withdrawn and the wax pattern gates 14 are brought into contact with the wax runner 13 to create fusion.

[0028] Referring now to FIGS. 2 and 3, a knife 21 in accordance with this invention is shown. The surface 22 of the knife 21, shown in FIG. 2, heats the wax runner 13. The surface 23 of the knife 21 contacts the wax pattern gates 14. FIGS. 2 and 3 show the surface 22 of a knife 21 for contacting the wax runner 13. Surface 22 is formed with three v-shaped grooves 27 in it. Two of the grooves 27 are close to the edge 29 of the surface 22 which contacts the wax runner 13, and another v-shaped groove 27 is located generally equally between the two v-shaped grooves 27 that are close to the edges 29 so that grooves 27 are equally spaced based on the width of surface 22 of the knife. Although surface 22 has three approximately equally-spaced grooves in the example illustrated in FIGS. 2 and 3, surface 22 can have any number of approximately equally-spaced grooves. In FIGS. 4 and 5, there is shown a variation to the configuration of FIGS. 2 and 3, namely a concave surface 31 extending across the width of the surface 22 of the knife 21 adapted for contacting the wax runner 13.

[0029] The cross sections shown in FIGS. 3 and 5 are just two of numerous possibilities. The exact configuration is not vital. A common feature of both FIG. 3 and FIG. 5 is a space in the knife 21 in which molten wax will flow when the knife 21 is pressed against the wax runner 13. With a knife 21 having a surface 22 which is flat, the molten wax is forced outwardly, which readily can result in the undesirable condition of molten wax flowing over the sides 33 of the wax runner 13. By having at least a portion of the surface 22 between the edges 29 of the knife 21 recessed or withdrawn slightly away from the wax runner 13, a space is provided to receive molten wax while retaining that molten wax under the knife 21. Thus, the v-shaped grooves 27 of FIG. 2 and FIG. 3 as well as the concave surface 31 as shown in FIG. 4 and FIG. 5 provide a space where melted wax can be held to prevent that wax from flowing over the sides of the wax runner 13.

[0030] In FIGS. 6 and 7 and FIGS. 8 and 9 conformal surfaces 35 are shown. In FIGS. 6 and 7 the conformal surfaces 35 are flat while in FIGS. 8 and 9 the conformal surfaces 35 have grooves 36. The conformal surfaces 35 protrude slightly beyond a base surface 37 of the knife 21. The grooves 36 provide the space for molten wax to be held further to avoid wax running over the sides of the wax runner 13 as has previously been explained. With conformal surfaces 35, the wax runner 13 is heated only in the area where the wax pattern gates 23 are to be connected the wax runner 13. The configuration of the conformal surfaces are designed to conform to the shape of the wax pattern gate 14 to be fused to the wax runner 13. The polygram configuration of the conformal surface 35 shown in FIGS. 6 and 8 is merely illustrative. The conformal surface 35 eliminates melting for substantially the length of the wax runner thereby melting less wax and as a result, reducing the possibility of wax running over the side of the wax runner 13 due to a reduction in the area of the wax runner 13 that is heated. As a result there is an elimination of any flow of wax where heating is not required.
As can be seen in FIGS. 7, 9 and 10, a heating element 39 is located in the knives 21. The heating element 39 is controlled by a temperature sensor 41 (FIG. 10) also located in the knife 21, which determines the temperature of the knife 21. As a result, the melting temperature of the wax is controlled. The flash temperature of wax, generally speaking, is about five hundred degrees Fahrenheit. At the flash temperature, volatilities, which are undesirable, are emitted into the atmosphere. By use of the electrical control system shown in FIG. 11, the knife 21 is held to a temperature under the flash point, and the attachment of the wax pattern gate 14 to the wax runner 13 is accomplished without undesirable volatilities being released into the atmosphere.

FIG. 11 illustrates an electrical circuit diagram for a control system for the heating element 39 in the knife 21. The control system of FIG. 11 includes an alternating current power supply 43. The power supply 43 is fed through a circuit breaker 45 into a temperature controller 47 which is activated by the temperature sensor 41. When the temperature controller 47 detects a specified level of temperature in the knife 21, it breaks the supply of power to the heating element 39 through a solid state relay 51, which opens and closes a solid state contact 53 in series with the heating element 39.

It is to be understood that the drawings and description matter are in all cases to be interpreted as merely illustrative of the principle of the invention, rather than as limiting the same in any way, since it is contemplated that various changes may be made in various elements to achieve like results without departing from the spirit of the invention or the scope of the appended claims.

1. A wax tree assembly heating system for heating a wax surface comprising:

   an elongated bar of heat conducting material having a plurality of raised heating surfaces configured to contact at least one of a pattern gate and a wax runner; and

   means for heating the raised heating surfaces.

2. The system of claim 1, wherein the heating surface comprises a recessed area for retaining molten wax.

3. The system of claim 2, wherein the recessed area comprises a concave surface.

4. The system of claim 1, wherein the heating surface comprises at least one groove.

5. The system of claim 4, wherein a width of a cross section of the at least one groove becomes smaller at a greater depth of the at least one groove.

6. The system of claim 4, wherein the at least one groove has a v-shaped cross section.

7. The system of claim 1, wherein the means for heating the heating surface comprises an electrical heating element.

8. A wax tree assembly heating system for producing molten wax on a plurality of areas on one or more surfaces of at least one wax component comprising:

   an elongated bar of heat conducting material having a plurality of raised heating surfaces configured to contact at least one of a pattern gate and a wax runner; and

   means for heating the raised heating surfaces.

9. The system of claim 8, wherein at least one of the raised heating surfaces comprises a recessed area for retaining molten wax when the raised heating surfaces contact the at least one of the pattern gate and the wax runner.

10. The system of claim 9, wherein the recessed area comprises a concave surface.

11. The system of claim 8, wherein at least one of the raised heating surfaces comprises at least one groove for retaining molten wax when the raised heating surfaces contact the at least one of the pattern gate and the wax runner.

12. The system of claim 11, wherein a width of a cross section of the at least one groove becomes smaller at a greater depth of the at least one groove.

13. The system of claim 11, wherein the at least one groove has a v-shaped cross section.

14. The system of claim 8, wherein the means for heating the raised heating surfaces comprises an electrical heating element.

15. The system of claim 8, wherein at least one of the raised heating surfaces conforms to a shape of the pattern gate to be fused to the wax runner in assembling a wax tree.

16. The system of claim 8 further comprising a temperature controller for controlling the means for heating.

17. The system of claim 16 further comprising a temperature sensor, wherein the temperature sensor provides a signal indicating a temperature of the elongated bar to the temperature controller.

18. A method of heating wax on a surface of a wax component using a wax tree assembly heating system having a heating surface in preparation for fusing the wax component to another wax component in assembling a wax tree, wherein the method comprises:

   providing an elongated bar having a heating surface configured to provide a space for molten wax to be retained when the heating surface contacts a wax component;

   heating the heating surface; and

   temporarily positioning the heating surface of the elongated bar in contact with the wax component.

19. The method of claim 18, wherein the heating surface comprises a plurality of raised areas configured to provide spaces for molten wax to be retained when the heating surface contacts the wax component.

20. The method of claim 19, wherein the wax component comprises one of a wax runner and a wax pattern, and at least one of the plurality of raised areas conforms to a shape of a gate of the wax pattern to be fused to the wax runner.

* * * * *