Title: IMPROVED CONTAINER CANDLE

Abstract: The present invention relates to container candles, such as melting plate candles, which employ heat conductive elements to distribute heat from a burning flame at a wick (3) to a support plate (2) for a solid fuel (4) and to the body of said solid fuel, so as to more rapidly liquefy the solid fuel, such as paraffin wax, and to more uniformly and intensely heat such fuels to increase the efficiency of consumption thereof. The container (18) of said candle is treated by the application thereto of a thin layer of a low emissivity coating material (15), such as a doped tin oxide, and the heat conductive support plate is configured so as to have a capillary pedestal upon the surface thereof, which cooperatively engages a wick holder comprising heat conductive fins which conduct heat from a flame upon said wick to said support plate.
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IMPROVED CONTAINER CANDLE

RELATED APPLICATION(S)

5  [0001] Not applicable.

FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not applicable.

BACKGROUND OF THE INVENTION

Field of the invention

15  [0003] The present invention relates to a container candle comprising a conventional candle located within a candle holder preferably made of glass. In the preferred embodiments of the invention, the improvement is specifically related to melting plate candles comprising a container, a melting plate, a wick holder, and means to secure the wick clip or wick holder assembly to the melting plate candle, said candle assembly further comprising a replaceable wick and/or fuel puck. This invention is most particularly designed to be used in a melting plate candle having means to provide a capillary feed between the wick holder and the melting plate, as well as in jar candles or conventional container candles. It is to be noted that the primary concept of the present invention, although most effective in a melting plate candle environment, is also useful in any conventional candle utilizing a solid fuel element and a wick upon which fuel is consumed. Although the preferred embodiments of the invention relate to melting plate candles, the invention is broadly applicable to any form of container candle.

Description of the Related Art
Conventional candles are well known, and may constitute such various forms as candle sticks, jar candles, votive lights, tea lights, melting plate candles, and other forms. The present invention relates to those forms of candle in which a solid fuel element is contained within a container, preferably of a glass material so as to permit the passage of light from the flame on the wick to the surrounding area.

Recently, melting plate candles and simmer plate dispensers have been used to provide rapid melting of a solid fuel element and/or rapid dispensing of a vaporizable material to the atmosphere. An example of such a dispensing device is shown in US Patent 6,780,382, issued August 24, 2004, in which a dispenser for active materials is shown. This reference, incorporated herein by reference, illustrates a melting plate dispenser of volatile materials comprising a solid fuel containing active material, a consumable wick, and a heat conductive base having conductive elements, and the configuration of such elements.

In US Patent 6,802,707, issued October 12, 2004, a melting plate candle comprising solid fuel, a consumable wick, a concave melting plate comprising a lobe by which heat is conducted from the flame upon the candle to the plate, and the configuration of such elements, are shown.

In addition to the above, in Application Serial Number 10/780,028, filed February 17, 2004, a candle comprising solid fuel, a melting plate, a lobe which engages a wick holder comprising a wick and conducting heat to said lobe and to said melting plate is taught, wherein said wick holder engages said lobe in such a manner as to create a capillary flow of melted fuel to the wick itself.

In each of the above references, the melting of solid fuel is facilitated by the presence of a melting plate, and by other heat conductive surfaces, such as heat fins which are part of the wick clip. In addition, the use of conductive lobes is suggested to further distribute heat from the flame to the solid fuel element and to the liquid fuel resulting from melting of the solid fuel. Although these references do teach improved methods for distributing heat to the solid fuel element and to the liquid fuel, it is to be noted that considerable heat is lost by radiation to the surrounding atmosphere, or to the container walls which may
comprise materials which are not well suited to conduct heat back to the fuel
element or the liquified fuel, but can be heated by the flame to an external surface
temperature which is uncomfortable or possibly excessive to the touch. The
present invention is directed to a method whereby more of the heat generated by
the flame upon the wick may be captured and used to more efficiently melt the
fuel element and the pool of liquid fuel, while not heating the container surface to
the point that the container surface is unsafe to the consumer.

SUMMARY OF THE INVENTION

[0009] The present invention relates to a candle holder or container having
a reflective or low emission coating applied to the inner surface of the candle
holder for the purpose of raising the temperature of the wall so as to assure
complete and more rapid melting of the wax adjacent the container wall. By
coating of the inner surface of the container, in those areas subject to the radi-
ation of heat from the burning candle, not only is one able to more efficiently heat
said surface, but one may, by proper choice of the coating material, assure that
the internal surface temperature is elevated sufficiently to assure melt of all wax in
contact therewith, while the external surface is not raised to an unsafe tempera-
ture.

[0010] The present invention, designed for use with a candle holder or
dispenser of actives such as a melting plate candle, as described above, but
suitable for use with most forms of container candles and/or dispensing devices,
may also provide a means for retention of the wick holder at a specific central
position, by use of a retention means designed to fit over and around, or within, a
specifically positioned pedestal or depression or opening within the bottom of the
melting plate.

[0011] Specifically, the wick holder of the preferred embodiment of the
present invention comprises a wick holder designed to provide heat fins, a wick
positioning holder, and a base designed to not only engage a similarly shaped
portion of the bottom of the container, in such a manner as to prevent its easy
displacement from the bottom of the container, but to also create a capillary flow of melted wax, or liquefied active containing material, between the wick holder itself and the portion of the bottom by which it is engaged. Such an embodiment is shown in US Patent Application Serial Number 10/780,028, filed February 17, 2004, incorporated herein by reference.

[0012] The present invention thus provides a candle or lamp device capable of rapidly and completely melting a solid fuel to form a large liquid pool, with little or no incomplete melting of wax adjacent the container, thus ensuring efficient and complete utilization of all of the fuel provided, while providing increased safety by limiting the external surface temperature of the container external surface. Further, the concept of the present invention offers highly decorative as well as functional candles and lamps, which may utilize a variety of gel and solid fuels, with the significant advantages of permitting rapid and convenient replacement of one fuel element by another at the desire of the consumer, without the need to clean or scrape the container in which said candle is utilized.

[0013] These and other embodiments of the invention shall be illustrated in the figures and description which follow.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Figure 1 illustrates the basic concept of a melting plate candle of the prior art, in simplified perspective view, of which the present invention constitutes an improvement.

[0015] Figure 2 illustrates a basic melting plate candle, in simplified cross section, absent the locking wick holder of the preferred embodiment, showing the area of the container to which a low emissivity coating is preferably applied.

[0016] Figure 3 is an exploded view of a melting plate having a capillary pedestal, with a wick holder with fins and incorporated wick, and a fuel element.

[0017] Figure 4 is a perspective view of the assembled melting plate, wick holder, and fuel element of Figure 3.
DETAILED DESCRIPTION OF THE INVENTION

[0018] Ordinary candles comprise a vertical, self-supporting body or column of wax, with a substantially horizontal top and a central longitudinal wick which extends through and above the wax. The exposed portion of the wick above the solid wax is lighted by a flame, and the heat generated by the flame melts a small volume of the wax at the top of the candle, adjacent the wick, establishing a puddle or reservoir of molten wax to serve as fuel for the flame on the wick, and to release any volatile actives present therein. The capillary attraction of the molten wax and the wick, which is generally a structure of closely related fibers, causes the molten wax to travel through the wick to the flame, by which it is consumed. As the wax is consumed in this manner, the body of wax diminishes and the top surface thereof progressively lowers. The upper portion of the wick, extending above the lowering wax, is generally consumed by the flame. The flame in such a candle remains in the same position relative to the horizontal center of the candle, but decreases in height relative to the surface upon which the candle rests, from the start to the end of the burn, at which time all or at least most of the wax has been consumed.

[0019] Also well known are such candles as votive candles and tea lights. For purpose of discussion, tea lights shall be considered to be relatively small candles in which a body of paraffin is located in a container, having a wick centrally disposed, while votive candles shall be considered to be candles of similar size provided without a container, and intended to be placed in a container of the consumer’s choice. At the lower end of the wick is typically found a wick clip having a flat horizontal bottom surface, which functions to retain the wick in its perpendicular position, even as the paraffin is melted and liquefied by the heat of the flame. In most such votive candles and tea lights, the wick is a cotton material saturated with paraffin, and burns with the paraffin, thus being consumable. In such candles, or lights or warmers employing the same, the visible flame moves lower, or closer to the bottom surface of the container as the fuel and wick are consumed, down to the level of the bottom of the wick. Further, after con-
sumption of all of the wax above this point in the unit, the container (of the tea light), the unburned wax, and the wick clip remain to be disposed of by the consumer. As a safety consideration in such candles, the wick is normally crimped or terminated at a point about 0.25 inches above the bottom of the wax, so as to cause the flame to extinguish above the bottom of the container, and to thus prevent the heat of the flame from reaching the surface upon which the candle is positioned, preventing damage to such surface, and reducing the likelihood of igniting possible contaminants such as burnt matchsticks remaining at the bottom of the candle, or carbonaceous remains of the consumable wick.

Such an arrangement also has the detriment of leaving a small volume of unburned wax in the bottom of the container when the flame extinguishes.

As utilized herein, the term melting plate candle shall encompass the combination of a solid fuel element and a heat conductive container or holder for the fuel. The terms fuel container and fuel holder shall be meant to encompass a support plate or melting plate comprising means to contain and melt the fuel element, and a wick holder engaging a wick and said support plate, said wick holder comprising heat conductive elements, such as fins, referred to hereinafter as either wick fins or heat fins. Said wick holder may also encompass a base having a skirt or legs configured to engage a complimentarily shaped pedestal portion of the support plate, and to transfer heat from a flame upon said wick to said melting plate. Thus, the support plate functions to hold the fuel element, to retain the wick holder, and to conduct heat to the solid fuel element to thereby melt said fuel element to provide a liquid fuel to feed to the flame via the wick. Moreover, the base portion of the wick holder may engage, by the use of legs or skirt means, or by magnetic means, a pedestal on the surface of said support or melting plate in such a manner as to resist detachment from the melting plate, while also providing a means for transporting liquid fuel from the support plate to the wick by capillary action. Thus, the pedestal to which the wick holder is attached may be referred to as a capillary pedestal, whereas in previous melting plate candles, in which no locking or attachment means is present to secure the wick holder to the base of the melting plate, the wick holder is said to engage a
capillary lobe. The capillary pedestal may thus be considered to be a capillary lobe having means by which a wick holder may be engaged so as to resist accidental displacement. The wick holder may thus be considered to be retained in place by the capillary pedestal, although it is removable by the consumer for replenishment of the wick and/or the fuel element, by exertion of sufficient force to overcome the engaging pressure. As will be appreciated, the manufacturer may provide melting plate devices, wicks and wick holder assemblies, and solid fuel elements, either together, or independently (separately), and the consumer may join the separate elements to form a melting plate candle, fuel burner, or dispenser of active materials, with the option to change wicks and fuel elements at will. In a preferred embodiment of the invention, the wick, wick holder, and fuel element may be provided as a unitary replacement element to be utilized with a separately provided melting plate.

[0021] The key element of the present invention constitutes a coating of a low emissivity material to the interior surface of the container in areas subject to radiation of heat from the flame upon the wick. By the term low emissivity material, it is meant to imply a coating material having high reflectivity of radiant heat, while also exhibiting relatively low conduction of radiant heat to the substrate upon which the coating is applied. Such coating materials may comprise, for example, a thin layer of tin oxide, or doped tin oxide. Alternatively, a coating of pyrolytic graphite, or silicon carbide, may be applied to the interior surface of the candle container. As indicated, this coating may be of such a material as a fluorine doped oxide, and should be thin enough to not obstruct view of the flame from the exterior of the container wall, if said wall is transparent, such as glass.

Other materials, such as tin oxide, or other reflective metals, may be applied in single crystal layer thicknesses, by conventional application methods known to those skilled in the art. The purpose of such a coating is to allow a reduction of heating of the wall surface by radiation, while reflecting heat back toward the solid fuel in the container. This technique has been found to lower the outer wall temperature of the candle container, while providing a suitably high temperature within the container to prevent wax retention. This invention has been found to
be effective on various materials of candle container, such as glass, metals, ceramic, and other normally used candle containers. Similarly, it is possible to apply a coating to the container surface so as to form a one-way mirror surface, which will reflect light, and radiant heat, back to the interior of the container, while permitting the interior to be visible from the outside, and increasing the brightness of the candle. Such one-way mirror effects may be achieved by a wrap applied to the surface, or by spray application. In addition to the above, it is also possible to form a reflective iridescent glass container, such as by application of a tin oxide coating to a glass container during manufacture, while the container is still hot.

Still further, it is possible to utilize a topper for a container candle, wherein the interior surface of the topper is coated with a low emissivity material so as to reflect heat back to the surface of the fuel, as long as said topper has sufficient openings therein to permit adequate oxygen to reach the flame to support combustion.

[0022] It is to be noted that for safety considerations, the external surface of a glass candle holder should not exceed 150°F. Another consideration is that little or no residual wax is left on the side of the container wall, which can occur when the wax close to the wall does not reach its melting point of about 125°F, and the flame tunnels down through the center of the wax puck.

[0023] According to consumer studies, contained candles suffer from two major problems, namely (1) retention of wax at the end of candle life, and (2) poor fragrance delivery for those candles containing volatiles. The first issue, retention of wax, results from incomplete melting of wax in the region in close proximity to the container wall. Any attempt to melt this wax by lowering the diameter of the container and/or by increasing flame size does increase the wall temperature, but to levels which make it unsafe for the consumer to handle. This is due to the small difference of about 30°F between the melting temperature of wax and the highest temperature that the container wall may reach without causing skin burn. Any approach that can lead to lower wall temperatures, while ensuring no retention of wax, is thus very desirable.
[0024] Fluid dynamics calculations were conducted to understand the heat transfer phenomena in contained candles. On the basis of such calculations, it was established that the main cause for an increase in wall temperature is due to radiant heat from the flame to the wall. Accordingly, it was predicted that wall temperature could be kept low if the absorption of radiant heat is limited by the presence of a low emissivity material on the inside wall of the container. This low emissivity coating effectively reflects heat back toward the flame, and by proper container design may be directed toward the wax pool, the solid fuel element, or the ambient atmosphere outside the container.

[0025] Experiments were conducted to verify this theory, in which contained candles were prepared with identical containers of glass that was either treated with a low emissivity coating or not so treated. The wall and pool temperatures of these candles were measured by using both infrared cameras and thermocouples. These measurements showed, as predicted, that the wall temperature are lower by more than 10 degrees and the pool temperatures were either the same or only differed slightly. The experimental results are shown in Table I, below. These experiments were conducted using 75 mm tall glass cylinders of identical diameter and thickness, with temperature readings taken after 4 hours of burning to permit the candle to reach equilibrium.
Table I

Experimentally Determined Candle Wall Temperatures

<table>
<thead>
<tr>
<th></th>
<th>Standard Glass Degrees F</th>
<th>Low Emissivity Degrees F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside Wall IR Camera</td>
<td>118</td>
<td>105</td>
</tr>
<tr>
<td>Inside Wall IR Camera</td>
<td>121</td>
<td>111</td>
</tr>
<tr>
<td>Wax Pool Surface IR Camera</td>
<td>185</td>
<td>185</td>
</tr>
<tr>
<td>Outside Wall Thermocouple</td>
<td>127</td>
<td>117</td>
</tr>
<tr>
<td>Inside Wall Thermocouple</td>
<td>140</td>
<td>124.5</td>
</tr>
<tr>
<td>Wax Pool Interior Thermocouple</td>
<td>145</td>
<td>161</td>
</tr>
</tbody>
</table>

[0026] From the above, it may readily be seen that the external surface of the glass container was considerably cooler for the coated glass than for the uncoated glass, and that the inside temperature of the uncoated glass container was also warmer. However, and most importantly, it is to be noted that the temperature of the wax pool of the coated container candle, as measured by a thermocouple beneath the surface, was considerably higher than the wax pool of the uncoated container candle. In fact, the temperature of the wax pool of the coated container candle was above the melting point (150°F) while the temperature of the wax pool of the uncoated container candle was below the melting point. Clearly, this would lead to a much lower degree of wax retention in the coated candle container.

[0027] In addition to the base and/or skirt of the wick holder being a heat conductive element, the wick holder may preferably also provide an additional heat conductive element such as a fin or fins, which may be in close proximity to, or in contact with the flame, and thereby conduct heat back to the wick holder base, and thus to the capillary pedestal, and thereby to both the melting plate and the fuel. Further, this fin or fins may be positioned so as to absorb additional heat reflected back from the low emissivity coating upon the container walls.
[0028] It is to be understood that this arrangement of elements provides for much greater control of the degree of heating of the pool of melted wax, and the pool temperature, by virtue of the ability to control the amount of heat conducted to the pool by either the skirt of the wick holder or by the fins thereof. This may be accomplished by proper configuration of the container walls so as to reflect back to a chosen location within the container, or perhaps by the number of fins, for example, or control of the conductivity thereof, such as by choice of position relative to the flame and or the container walls, or material of construction. This in turn is most important in candles which dispense a volatile material, such as a fragrance, where a rapid temperature rise to the most effective temperature for volatilization of the active material is desired. Such a rapid temperature rise clearly results in a more rapid melt of the fuel element, and a more rapid dispensing of volatile material. In fact, with the present invention, it is possible to tailor a melting plate candle to a specific volatile active to be contained within a fuel element, by permitting control of the amount of heat conducted to the pool of melted fuel, and thus controlling the temperature thereof.

[0029] Alternative aspects of the present invention provide for the fuel element to be provided as a separate element which is complementarily shaped relative to the wick holder, so as to fit around the wick holder in its position on the capillary pedestal of the melting plate, if present. While it is possible for a permanent wick and wick holder assembly to be provided as a part of the melting plate, in a preferred embodiment of the invention the wick holder, wick, and fuel element are provided to the consumer as a single unit. Alternatively, the wick and wick holder may be provided as a single unit, with individual separate fuel units, perhaps containing differing fragrances, for example, to be combined with a melting plate. In this manner, wick holders of differing shape and configuration may be combined with fuel elements of appropriate configuration which differ in color or scent, for example.

[0030] Accordingly, the melting plate, or the container itself if no separate melting plate is present, is preferably comprised of a heat conductive material, such as a metal, although less conductive materials, such as glass, or ceramic
may be employed with less efficiency due to lower conductivity. Heat resistant plastics may also be utilized, in view of the protection afforded by the presence of the low emissivity coating. The preferred material for use as the melting plate is polished aluminum, due to its high efficiency as a conductor of heat, its light weight, and for aesthetic reasons. It is also possible that the melting plate may constitute a non-conductive body having a conductive surface applied thereto, such as a less conductive surface having a thin layer of metal applied thereto. In this regard, it is noted that the surface of the melting plate may also have a coating of a surface tension modifying material applied thereto for purposes of preparing a self cleaning or easy cleaning melting plate. For example, a thin layer of a polytetrafluoroethylene material may be applied over a rough surface to provide a smooth wetting surface upon which molten wax will flow easily, and which will enable still easier removal of any solidified wax upon extinguishing the flame and allowing the candle to cool.

[0031] The melting plate, which may constitute both the fuel container and a heat transfer means to heat the fuel, is shaped so as to collect the melted or liquefied fuel at its lowest point, at which point a wick is preferably located by means of a wick holder positioned upon a capillary pedestal, so as to ensure that all fuel is fed to the wick, whereby the maximum consumption of the fuel is achieved. Thus, the melting plate is preferably shaped as a bowl, or in the form of a funnel, with the lowest portion thereof preferably, but not necessarily, centered. The entire interior surface of the fuel container is preferably highly heat conductive, and supports, contains, and heats the fuel, although containers in which only a small portion of the interior surface acts as a melting plate are within the scope of the present invention. Candles employing such melting plates shall be referred to, collectively, as melting plate candles. The melting plate itself may, of course, be essentially flat, with raised edges or a surrounding wall to contain the melted fuel.

[0032] Moreover, the melting plate helps to control the shape and depth of the pool of fuel which is burned at the wick, and to maintain the constancy thereof. It is to be understood that the fuel utilized in the present invention may
be initially in solid or gel form, but must be in liquid form for moving up the wick by
capillary action to the flame, where it is consumed. Thus, the fuel used with the
melting plate candle shall be such that it will not be transported by wicking action
at ambient or room temperature, but requires heating to a liquefied state, i.e.
melting, to be subject to capillary or wicking action. For convenience, the term
solid fuel shall be used hereinafter to refer to fuel in either a gel or conventional
solid state, such as conventional candle wax, preferably in the form of a hard,
shaped body or "puck" of wax. It is also to be understood that the fuel consumed
in the flame at the burning wick is drawn by the wick from a liquid pool of fuel,
which pool is formed by melting the solid fuel, and heating said liquid pool by
conductive heat transfer from the melting plate and heat exchange elements
provided by the wick holder, in addition to the radiant heat from the flame on the
wick. By the use of the melting plate technology of the present invention in
addition to the conventional radiant heating of the surface of the fuel, the size,
volume, depth, and temperature of the liquid pool of fuel are better regulated.
And, as a result of greater control of heat transfer to the fuel, a melted, liquid pool
thereof is more rapidly formed and heated to a desired temperature. Because the
speed of achieving a uniformly heated liquid pool of fuel is increased, a more
efficient consumption of the fuel results, and a more complete usage of available
fuel due to the decrease of fuel left unburned on the surface of the melting plate,
as well as a more efficient release of any volatile active materials in said fuel,
such as fragrances. In preferred embodiments of the present invention, a pool of
liquid, i.e. melted, fuel rests upon the surface of the heat conductive melting plate.
This pool of fuel may initially contain unmelted fuel in the solid state, as well as
melted fuel, and the elevated temperature of the pool achieved by the present
invention aids in assuring a complete melting of the solid wax puck and complete
and optimized dispersal of any volatile active materials present in the fuel. As a
comparison to a conventional candle, it may be seen that in the conventional
candle, the wax melts around the flame at the top of the wick, and as the wick is
consumed, the flame moves downwardly. In the present invention, the wax melts
around the flame, but the end of the wick is at a relatively constant height, and the
flame does not move rapidly downward. As a result, a more aesthetically pleasing candle is provided.

[0033] Generally, the melting plate device embodies both a melting plate and secondary heat conductive elements, which secondary elements may be provided as part of the wick holder and may be in close proximity to the flame, to ensure more uniform and rapid distribution of heat from the flame upon the wick. The wick is affixed in its preferred position by means of the wick holder. The wick, which is preferably a consumable wick, may be any filamentary body which is sufficiently sturdy, which will burn with a steady flame, and which is capable of drawing up the molten candle fuel by capillary action. Such a wick may be of any conventional consumable wick material, such as cotton, cellulose, nylon, or paper, but may be non-consumable as well. The wick holder and wick may preferably be located in the center of the candle, or may be off-center as desired. The presence of two or more wicks, and associated wick holders and capillary pedestals, is also within the scope of the present invention. In the present invention, the wick is positioned in a wick holder which engages the melting plate by means of an appropriately located capillary pedestal on the melting plate, which serves to locate the wick holder (and thus, the wick), to transmit heat from the flame on the wick to both the fuel and the melting plate, and by means of the capillary nature of the appropriately sized gap formed by the fit of the pedestal in relationship to the wick holder, to enhance flow of fuel to the wick. Moreover, the wick holder is preferably configured so as to also engage the fuel element in a lock and key relationship and to position it on the melting plate in the preferred location.

[0034] The primary heat conductive element constitutes the melting plate itself, which may comprise portions formed, raised, or bent to be in closer proximity to the flame, such as a raised section of the plate, e.g. the upper edge of the raised side of the melting plate. For example, the melting plate may constitute a bowl shaped container having its outer periphery in close proximity to the flame, such as a container in which the side wall of the bowl is formed so that the lip of the upper opening curves back toward the center of the bowl, and thus toward the
flame. The melting plate may also have secondary heat conductive elements, such as one or more raised portions which act not only to absorb and distribute heat by conduction, but to channel or direct the flow of liquid fuel to the wick. Such raised portions may constitute areas of material having higher heat conductivity than surrounding areas of the container. In such examples, the support plate may comprise a less conductive material, such as glass, and the primary heat exchange may be by radiant heat and conducted heat by means of the secondary heat conductive elements of the wick holder. It may thus be seen that the wick holder assembly, comprising a wick, and a fuel element, in conjunction with a base configured so as to complimentarily engage a capillary pedestal, may be utilized in any candle container comprising a capillary pedestal.

[0035] In the preferred embodiment of the present invention, a capillary pedestal both engages and positions the aforementioned wick, wick holder, and fuel element in such a manner as to provide the most advantageous positioning thereof, as well as to create a capillary flow of melted fuel from the melting plate to the wick positioned in the wick holder, which is placed in such close relationship to the capillary pedestal as to create a very narrow gap between the pedestal and the wick holder. By virtue of this narrow gap, which may be from approximately 0.01 to about 0.04 inches, preferably about 0.02 inches, liquefied fuel rises to the wick for consumption. It should be noted that it is within the scope of the invention that the capillary action may be improved as a result of grooves cut in the pedestal, or in the wick holder, and that the wick holder may be held away from the pedestal by the presence of appropriately positioned and sized bumps located on either the pedestal, the wick holder, or the melting plate. Moreover, the capillary forming combination of elements may constitute a concave depression in the melting plate, rather than a raised male pedestal, and the wick holder in such case may be an appropriately shaped male member which fits closely within the depression so as to create a capillary gap between the members, by which fuel is fed to the wick, and having engagement means to prevent its accidental removal from said depression. Still further, it is contemplated that the capillary pedestal, in a male configuration, or a female depressed configuration,
need not constitute a raised circular member, but may be of any shape, such as for example cylindrical, pyramid shaped, square, oval, triangular, or any other desired shape, in combination with a like-shaped and appropriately dimensioned wick holder and locking means. It is also to be noted that the capillary pedestal need not transmit liquid fuel to the wick at all parts of the perimeter of the capillary pedestal. For example, a circular capillary pedestal in conjunction with a circular wick holder need only create a capillary gap for a limited portion of its circumference, such as for 90, 180, or 270 degrees. Thus, the wick holder need not be in a close enough proximity to the pedestal throughout the total area of engagement therewith to provide a full capillary effect, but only in sufficient area to provide an adequate flow of fuel to the wick to maintain the flame upon said wick.

[0036] Additional secondary heat conductive elements may be separate assemblies which are utilized in conjunction with the melting plate and consumable wick and wick holder. The secondary heat conductive element may take the form of heat fins or heat conductive surfaces attached to the wick holder, and having either vertical or horizontal orientation or elements of both. In preferred embodiments, such heat conductive elements are heated by contact with the flame, or by heat radiation from the flame, and conduct such heat to both the melting plate and to the fuel so as to more efficiently heat the fuel. The secondary heat conductive elements of the wick holder, hereinafter exemplified as heating fins, although not limited to fins per se, and intended to encompass other heat conductive extensions of the wick holder which may serve this function, may be of any heat conductive material, and may be either formed as an extension of the wick holder or joined to said wick holder in such a manner as to conduct heat from the flame to that portion of the wick holder which is engaged by the capillary pedestal and/or the melting plate. The wick holder thus comprises fins, a means to hold the wick, the wick, and a base configured so as to engage the capillary pedestal of the melting plate, and to transfer heat from said fins to said melting plate. Suitable and exemplary, although clearly not the only possible heat fins are illustrated in US Patent 6,780,282, issued August 24, 2004, incorporated herein by reference.
[0037] It is to be understood that the wick holder and associated secondary heat conductive elements are meant to be so situated and shaped as to engage or interlock with a replaceable solid fuel element. In a similar fashion, the melting plate and/or the fuel container may be formed in such a manner as to permit placement of fuel elements of specific configuration, such as wax pucks having a complementary configuration, for example, in a preferred position in proximity to the heat conductive elements themselves, or to the wick holder, in such a manner as to maximize heat transfer from the melting plate to said fuel elements. In the most preferred embodiment, secondary heat conductive elements are present both on the melting plate, and as an element of the wick holder. In said most preferred embodiment of the invention, there is a capillary pedestal present on the melting plate, positioned in such a manner as to transfer heat to the fuel element, and configured so as to engage a wick holder holding a consumable wick and having one or more heat conductive fins, and a fuel element such as a wax puck. Further, the engagement of the wick holder with the capillary pedestal is such as to provide a capillary effect between the two for feeding fuel to the wick. In this embodiment, the consumer may purchase a replacement fuel element comprising a wax puck and a wick holder and wick, configured so as to engage a matching capillary pedestal on the melting plate in such a manner as to position the fuel element and the wick holder, and having a heat conductive element in the appropriate location to most efficiently melt the fuel element. Alternatively, the consumer may purchase an assembly comprising a wick holder and wick, with separately available appropriately shaped fuel elements.

[0038] The use of the melting plate technology, in conjunction with the low emissivity coatings applied to the candle container as taught by the present invention, may also provide such advantages as elimination of tunneling, significant reduction of retention of wax at the conclusion of the burn, and elimination of walking or off-center wicks, while also giving a larger pool of liquid wax with a relatively small flame in a relatively short time period. In addition, the container may be of almost any shape desired, providing for great aesthetic possibilities, within the range of those designs which are effective at reflecting heat back from
the low emissivity coated side walls to the solid fuel or to the melted wax pool. Since the fuel element, either alone or in combination with a wick and wick holder, may be provided as a separate unit, the consumer may be provided a great number of choices as to the color, content, and nature of the fuel, and the configuration of the fuel element may be varied to provide a large choice of shapes, such as seasonably decorative items. For example, shapes such as pumpkins may be provided for Halloween, wreaths for Christmas, and flowers for all seasons. In addition, the fuel element preferably is configured as to cooperatively engage both the melting plate and the wick holder, which wick holder in turn engages the capillary pedestal on the melting plate, in such a manner as to provide the consumer the greatest degree of ease in placement of the fuel element in optimal position in the melting plate candle, with the least possibility of incorrect placement. Further, both the melting plate or support plate and the container walls may have decorative features, such as designs, embossed, etched, printed, or stamped thereon.

[0039] Accordingly, the present invention provides a container or melting plate candle, wherein said candle comprises a container for a fuel element comprising a fuel selected from the group consisting of paraffin, beeswax, montan wax, carnauba wax, microcrystalline wax, polyvinyl acetate, fatty alcohols, fatty acids, fatty esters, and gels incorporating such fuels, in a form selected from the group consisting of pucks, donuts, chips, slivers, balls, pellets, shavings, particulates, cubes, discs, three dimensional shapes, and wafers, or in any other suitable shape. Said fuel element may optionally further comprise such volatile active materials as fragrances, air fresheners, deodorizers, odor eliminators, odor counteractants, insecticides, insect repellants, herbals, medicinal substances, disinfectants, sanitizers, mood enhancers, aroma therapy compositions, and the like. Such solid fuel may be colored for decorative effect, if so desired, and may be shaped to fit any given configuration of melting plate and/or wick holder. For example, the bottom of a solid fuel element should be curved complementarily to the shape of the melting plate upon which it is to rest, and have melting tempera-
tures above ambient, but below the flame temperature of a wick burning such fuel.

[0040] These and still other advantages of the present invention will be apparent from the description which follows, which description is merely of preferred embodiments, and not indicative of the full scope of the invention.

[0041] Figures 1 and 2 illustrate the broad concept of a melting plate candle in its most basic form, such as set forth in Patent Number 6,802,707, issued October 12, 2004, incorporated herein in its entirety by reference. Figures 1 and 2 illustrate the low emissivity coating of the container walls of the present invention, but do not show the capillary pedestal and wick holder assembly of the preferred embodiment of the present invention. As illustrated, a heat conductive melting plate container, 2, is provided, which transfers heat obtained from the heat source, a flame (not shown) located on wick 3, by means of heat conduction, to the solid fuel element, 4, which rests upon the surface of the melting plate. For purposes of illustration, and for clarity, but intending no limitation, the wick is illustrated as being of a relatively large diameter, rather than as a fibrous wick of small diameter. It is to be understood that the wick is positioned within and attached to the solid fuel element, 4, such as with a wick clip (not shown in figures 1 and 2). The melting plate, 2, which constitutes a container for the candle, as shown in Figures 1 and 2, is heated directly by a flame on the wick, 3, by radiation, as a result of the melting plate being shaped so as to have a portion, shoulder 18, in proximity to the flame, the diameter of the melting plate bowl being such as to permit the inner surfaces thereof to absorb appreciable amounts of heat from the flame, in the absence of the low emissivity coating of the present invention. In the present invention, a coating of low emissivity material, 15, is applied to the interior surface of the melting plate container, 2, so as to limit the absorption of heat by said surface, and to reflect radiant heat back toward the solid fuel element, 4. The interior surface may be coated, for example, with a thin layer of fluorine doped tin oxide, or other suitable coating material having the characteristics of high reflectivity of radiant heat and low conduction of radiant heat, covering its entire surface, or if so chosen, only that area of the surface
above the normal position of the wax puck and the pool of wax formed by melting of said wax puck. The height of said coating is a matter of aesthetics and choice, selected so as to achieve the desired results, while not inhibiting visual enjoyment of the visible flame by the consumer. However, if the container is of a material which is not transparent, the coating may be most easily applied to the entire interior surface, the thickness of said coating being determined by the degree of reflectivity necessary to achieve the desired result.

The melting plate of Figures 1 and 2 is shaped so as to have a raised outer shoulder, 18, thereby containing the resultant pool of melted fuel. It is to be understood that the melting plate may be in the form of a tray, bowl, concave plate, or other configuration which is capable of holding a pool of hot liquid fuel, and is preferably shaped so as to funnel or channel the liquefied, i.e. melted, fuel to the wick. The melting plate may constitute a container in itself, as shown, or may be surrounded by a separate container, to which the low emissivity coating of the present invention may be applied. In the embodiment shown in Figures 1 and 2, the melting plate rests upon a non-conductive base, 11, or legs of non-conductive or insulating material, so as to permit stable placement upon a table, counter, or other surface. The non-conductive base, as illustrated, comprises contact points, 12, so as to minimize the amount of contact between the base and the melting plate, and to create an insulating air gap, 13, between the melting plate and the surface upon which the assembly rests.

The melting plate may be of any heat conductive material, such as brass, aluminum, steel, copper, stainless steel, silver, tin, bronze, zinc, iron, clad materials, heat conductive polymers, ceramics, glass, or any other suitable heat conductive material or combination of such materials. As shown in Figure 2, the fuel is preferably located in direct contact with the surface of the melting plate, 2, which plate may, if desired, be constructed so as to have a non-conductive lower surface, so that the melting plate may rest upon a table surface or such. Such a configuration may result from a clad material, a conductive melting plate material coated on the external surface with a non-conductive material, a non-conductive material having an insert of a heat conductive material, or other suitable arrange-
ments to permit the melting plate to be cool enough on the bottom surface to permit ease of handling, and/or placement upon surfaces not suitable for contact with heated bodies. Of course, the use of the coating of the present invention has the beneficial effect of lowering the exterior surface temperature of the melting plate container, so that the use of a non-conductive lower or outer surface becomes of less importance.

[0044] The wick, 3, preferably constitutes a conventional consumable wicking material, such as such as cotton, cellulose, nylon, or paper, or the like, which by capillary action will carry liquid fuel to the flame. Alternatively, non-consumable wicks may comprise such materials as porous ceramics; porous metals; fiber glass; metal fiber; compressed sand, glass, metal, or ceramic microspheres; foamed or porous glass, either natural or man-made, such as pumice or perlite; gypsum; and chalk. However, for purposes of the present invention, the use of conventional consumable wicks is preferred. The wick, 3, may be located in the center of the melting plate, 2, or may be off-center as desired, provided that the melting plate is configured so as to channel or funnel melted fuel to said wick. As illustrated, the wick may be positioned in conjunction with a starter bump, 6, of wax in the top surface of said fuel element, 4, for ease of lighting. The presence of two or more wicks is also within the scope of the present invention. The wick is provided in conjunction with the wick holder assembly, the preferred configuration of the wick holder being such as to cooperatively engage a complimentarily shaped capillary pedestal, 22, on the melting plate, not shown in the present application, but illustrated in US Patent Application Serial Number 10/780,028, filed February 17, 2004, and incorporated herein in its entirety by reference.

[0045] Figure 3 is an exploded perspective view of a container candle having a capillary pedestal, with a wick holder with fins and incorporated wick, and a fuel element. Here, a bowl shaped melting plate container, 25, which comprises a capillary pedestal, 22, located in approximately the center thereof, comprises a melting plate bottom surface, 2. A wick holder, 7, is shown above the capillary pedestal, the wick holder being shaped in such a manner as to fit
closely over said capillary pedestal, and to engage said pedestal so as to be
locked in position. The wick holder, as illustrated, further comprises the wick, 3,
and a heat fin, 9. A solid fuel element, 4, is shown, having a cut out portion, 6,
through which the heat fin and wick assembly may pass, so as to place the wick
in close proximity to the top surface of said fuel element. The solid fuel element
is shown as a wax puck, although other shapes may clearly be used within the
scope of the present invention. Since difficulty in lighting the wick may be
encountered, a starter bump of fuel may be provided in close proximity to the
wick, 3. As illustrated in Figures 1, and 2, this bump is most easily molded
directly into the shape of the fuel element, and provides a ready source of liquid
fuel to the wick when a match or other appropriate source of flame is employed to
start the wick burning, which source of flame will melt the starting bump to thus
create an initial pool of liquid fuel. As shown, the side wall of said container is
coated with a low emissivity coating, so as to reflect radiant heat back toward the
center of said container, where said heat may be absorbed by the wax puck 4, or
by the heat fin, 9. The coating may be applied to the inner surface of said
container form the point at which the container contacts said melting plate, 2, up
to the shoulder of said container, 18.

[F0046] Figure 4 shows the embodiment of Figure 3 in operational configu-
ration, showing the relationship of the elements in position for lighting of the wick,
3, wherein the melting plate, 2, is shown with a fuel element, 4, positioned on the
capillary pedestal (22, not visible) and centered around a wick holder assembly
with the heat transfer fin, 9, and wick, 3, extending through the opening, 10. The
coating of the present invention is shown as element 15, on the interior walls of
the container, 25.

[F0047] Thus, when using a solid fuel, such as wax, in conjunction with a
heat conductive wick holder, solid fuel refill units may be shaped to fit the shape
of the melting plate, with a specific relationship to the wick holder, which itself is
engaged with the melting plate by a locking means. For example, the melting
plate may be a decoratively shaped container, and wax may be provided in the
form of refills specific for the container shape selected, such as round, square,
ovar, rectangular, triangular, or otherwise, so shaped that the wick holder assembly incorporated with the wax refill unit will fit and engage a complementarily shaped capillary pedestal.

[0048] The use of a container comprising a melting plate with additional heat conductive elements, such as the heat fins illustrated, in conjunction with the coating of the interior surfaces of the container by a low emissivity coating material, offers a number of distinct advantages. First, it permits a larger pool of liquid fuel, due to improved heat reflection into the fuel, which results in more rapid formation of the pool. This in turn allows better regulation of the size and shape, as well as the temperature, volume, and depth of the liquefied wax pool to allow more efficient use of fuels present. In fact, coated container candles comprising melting plates as set forth in the present invention permit ease of refill, with little or no cleaning, since little or no wax retention exists at the end of the candle burn. In most instances, no cleaning is required, but if desired, the plate may be conveniently washed in a manner such as a dish, plate of bowl is washed, in a wash basin or in a dishwasher. The use of a capillary pedestal in the heat plate, in conjunction with heat fins on the wick holder, also aids to reduce or eliminate retention of solidified excess fuel when the candle is allowed to burn itself out, and permits more complete and uniform burning of fuel elements which are other than round, i.e. square, oval, triangular, or in the shape of a flower or decorative object, etc. Further, combination of a low emissivity coating on the interior surface of a container for a candle, with the melting plate technology in conjunction with a capillary pedestal and complimentary wick holder, results in devices which may be self extinguishing, and improvements in or elimination of typical burning problems encountered with candles, such as tunneling, drowning, collapsing, cratering, and wick drift. Candles utilizing the combination of coated container walls with the melting plate technology, as taught by the present invention, are also more forgiving of formulation or process variances. And, more importantly, the presence of a retention mechanism for holding the wick holder in position on the capillary pedestal provides a margin of safety and convenience not previously available, while the application of the low emissivity coating of the
present invention results in a lower exterior surface temperature of the device, a significant safety enhancement.

[0049] While the present invention has been described with respect to what are at present considered to be the preferred embodiments, it is to be understood that the invention is not to be limited to the disclosed embodiments. To the contrary, the invention is intended to cover various modifications and equivalent arrangements within the spirit and scope of the appended claims. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent formulations and functions.

INDUSTRIAL APPLICABILITY

[0050] The melting plate and heat conductive element candles of the present invention, utilizing a capillary pedestal and correspondingly shaped locking wick holder, and having a coating applied to the interior walls of the container to limit heat absorption by said walls, can be used in connection with a large variety of solid fuels. The conductive materials of which the melting plate and heat fins may be constructed are commonly available, and the various configurations are readily produced. There is considerable interest for candles having extended burn times, and for refillable candles or solid fuel lamps, particularly for melting plate candles which are resistant to accidental release of the wick holder assembly.
Clubs

I claim:

1. A container candle comprising a melttable solid fuel element, a wick holder comprising a wick and engaging said melttable solid fuel element, the interior surfaces of the container being coated with a low emissivity coating so as to reflect radiant heat from a flame on said wick back toward said solid fuel element.

2. The candle of claim 1, wherein said fuel element further comprises one or more volatile active materials.

3. The candle of claim 2, wherein said wick holder further comprises at least one heat conductive heat fin.

4. The candle of claim 3, wherein said melttable solid fuel element comprises a replaceable fuel element cooperatively engaging said wick holder.

5. The candle of claim 4, wherein the replaceable fuel element further comprises a starter bump on the top surface thereof, in close proximity to said wick, for ease of lighting said wick.

6. A candle as set forth in Claim 1, wherein said candle further comprises a melting plate by which heat is conducted from a flame upon said wick to said solid fuel element, whereby a pool of heated liquid fuel is created, said melting plate being configured to cause the flow of said heated liquid fuel toward said wick holder.

7. The melting plate candle of claim 6, wherein said melting plate further comprises a pedestal upon which said wick holder is engaged.
8. The melting plate candle of claim 1, wherein said wick holder is configured so as to engage said pedestal so as to cause a capillary flow of liquid flow to said wick.

9. A candle comprising a melttable solid fuel, a support plate upon which said fuel rests, and a capillary pedestal located on said support plate which cooperatively lockingly engages the base portion of a wick holder comprising a wick, said wick holder conducting heat from a flame upon said wick to said capillary pedestal and said support plate, and said wick holder further contacting said melttable solid fuel, said candle having a container having the interior surfaces coated by a low emissivity coating.

10. The candle of claim 9, wherein said wick holder further comprises at least one heat conductive heat fin.

11. The candle of claim 10, wherein said melttable solid fuel comprises a replaceable fuel element cooperatively engaging said support plate, capillary pedestal, and wick holder.

12. The candle of Claim 9, wherein said low emissivity coating comprises a tin oxide.

13. The candle of claim 12, wherein said tin oxide is doped.
14. A candle consisting of a fuel holder comprising a heat conductive surface shaped to hold and melt a solid fuel material included in a replaceable solid fuel element further comprising a wick holder including a wick and heat fins, and to form a pool of liquid fuel, said surface further comprising a capillary pedestal which lockingly engages said wick holder, wherein said heat fins are configured so as to come in close proximity to a flame on said wick so as to conduct heat from said flame to said surface, and wherein said surface is shaped so as to cause said pool of liquid fuel to flow to said wick, and said fuel holder is coated with a low emissivity metallic material on the interior surface so as to prevent the exterior surface thereof from becoming excessively hot from radiant heat from said wick, and whereby radiant heat is reflected back upon the solid fuel material and said pool of liquid fuel so as to further heat said fuel.

15. The candle of claim 14, wherein said replaceable fuel element is configured to cooperatively engage said surface, and said low emissivity coating material comprises a thin layer of tin oxide.

16. The candle of claim 14, wherein said replaceable fuel element further comprises one or more volatile active materials.

17. The candle of claim 14, wherein the replaceable fuel element further comprises a starter bump on the top surface thereof, in close proximity but not in contact with said wick for ease of lighting said wick.

18. The candle of Claim 15, wherein said heat conductive surface further comprises raised heat conductive areas.

19. The candle of claim 14, wherein said heat conductive surface is treated so as to be self cleaning.
## INTERNATIONAL SEARCH REPORT

### A. CLASSIFICATION OF SUBJECT MATTER

F23D/16 C11C5/00

According to International Patent Classification (IPC) or to both national classification and IPC

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F23D C11C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>US 6 439 880 B1 (RAY ROBERT) 27 August 2002 (2002-08-27) figures 8-10</td>
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* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
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- "A" document member of the same patent family

** Date of the actual completion of the international search **

30 March 2006

** Date of mailing of the international search report **

06/04/2006

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