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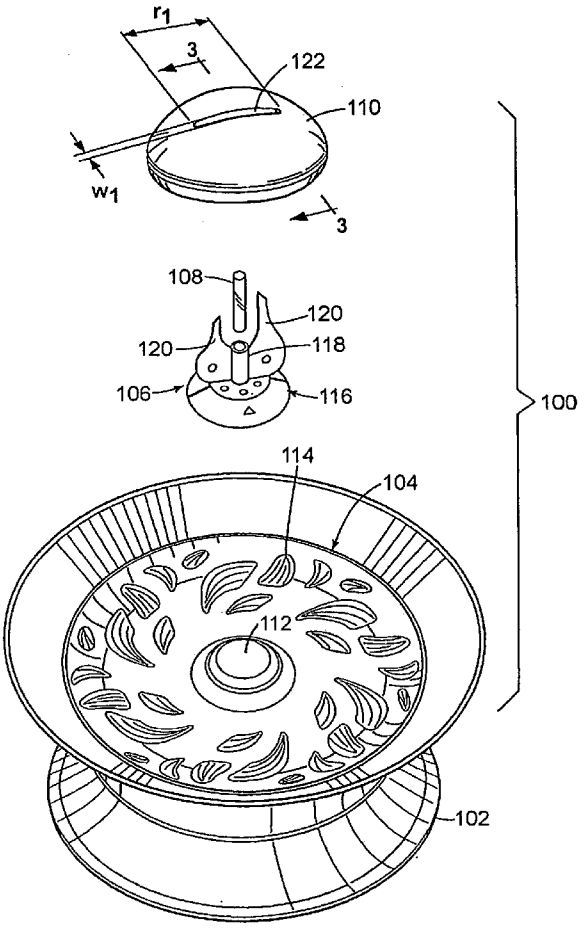
F23D 3/16 (2006.01)

(52) **U.S. Cl.** **431/291**

(57) **ABSTRACT**

In one aspect of the present invention, a wick holder adapted to hold a wick extending upwardly from a pool of liquefied fuel is provided. In one embodiment, a flame on the wick does not directly engage the pool of liquefied fuel. The wick holder includes a base portion that forms a capillary space with a capillary pedestal. A wick retainer is disposed above the base portion and retains the wick over the base portion. One or more openings through the base portion and an opening in the wick retainer disposed over the base portion provides a path for liquefied fuel to flow from the capillary space to the wick via the holes in the base portion, across a top of the base portion, and through the opening in the wick receiver.



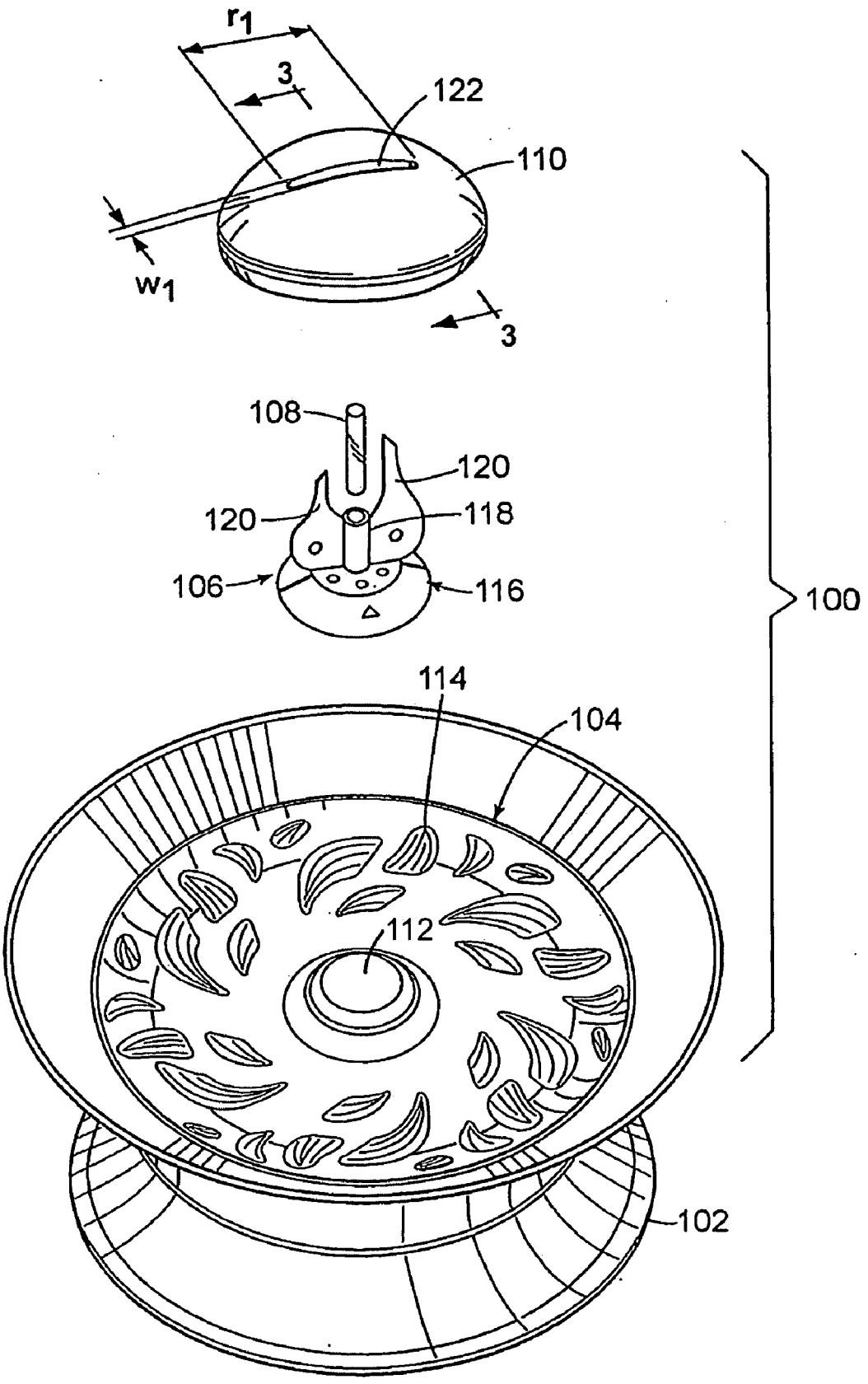
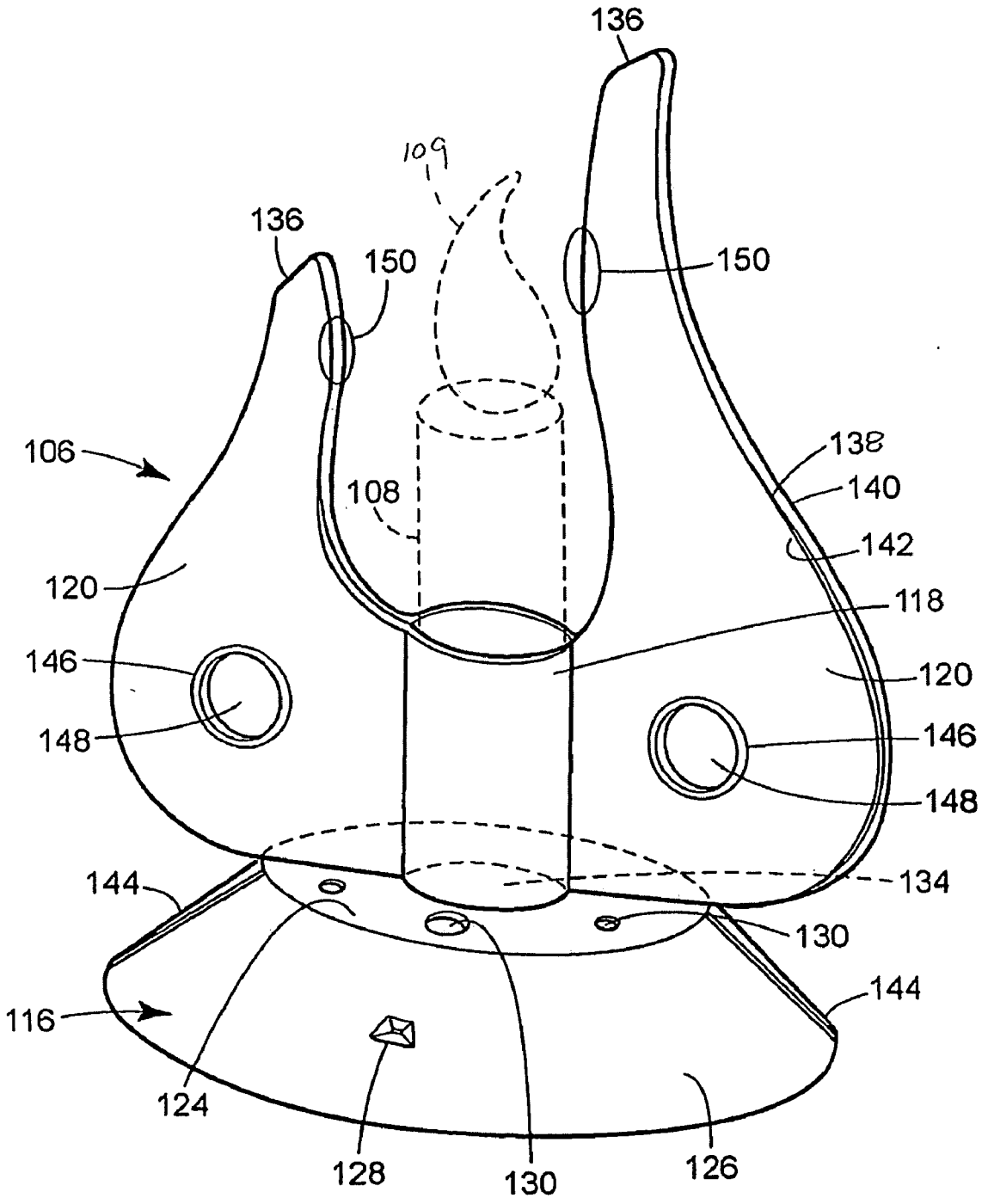


FIG. 1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109
136
150
150
106
108
138
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116
124
128
130
126

FIG. 2

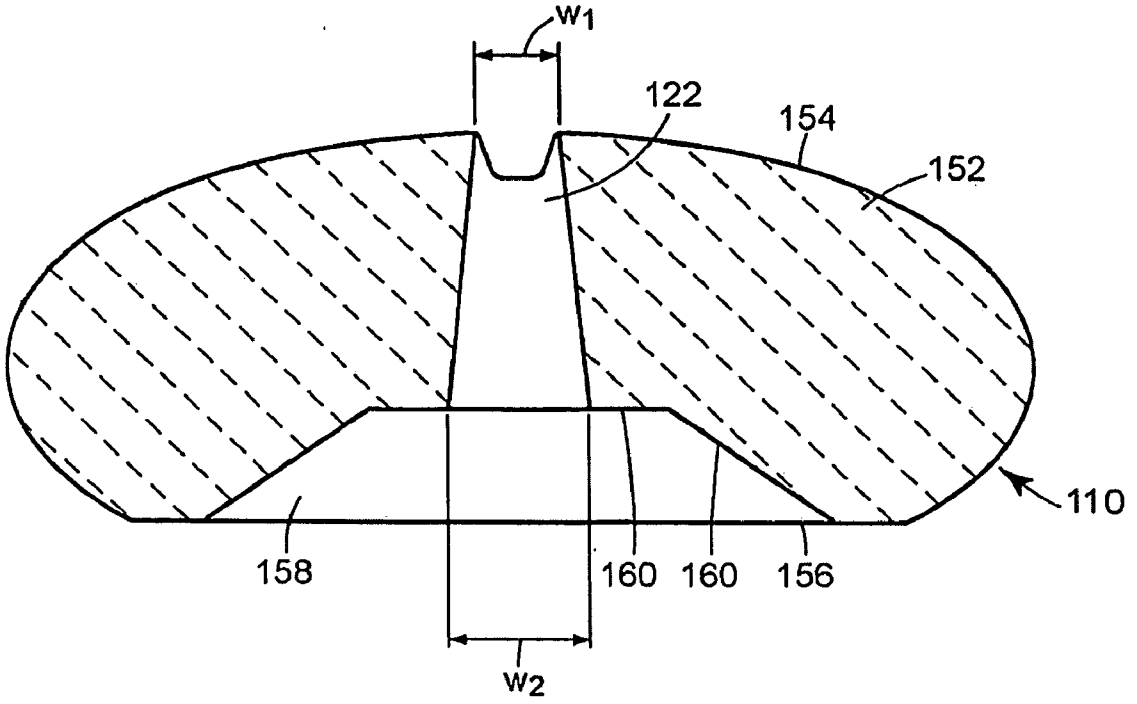
W1
122
154
152
110
158
160
160
156
W2

FIG. 3

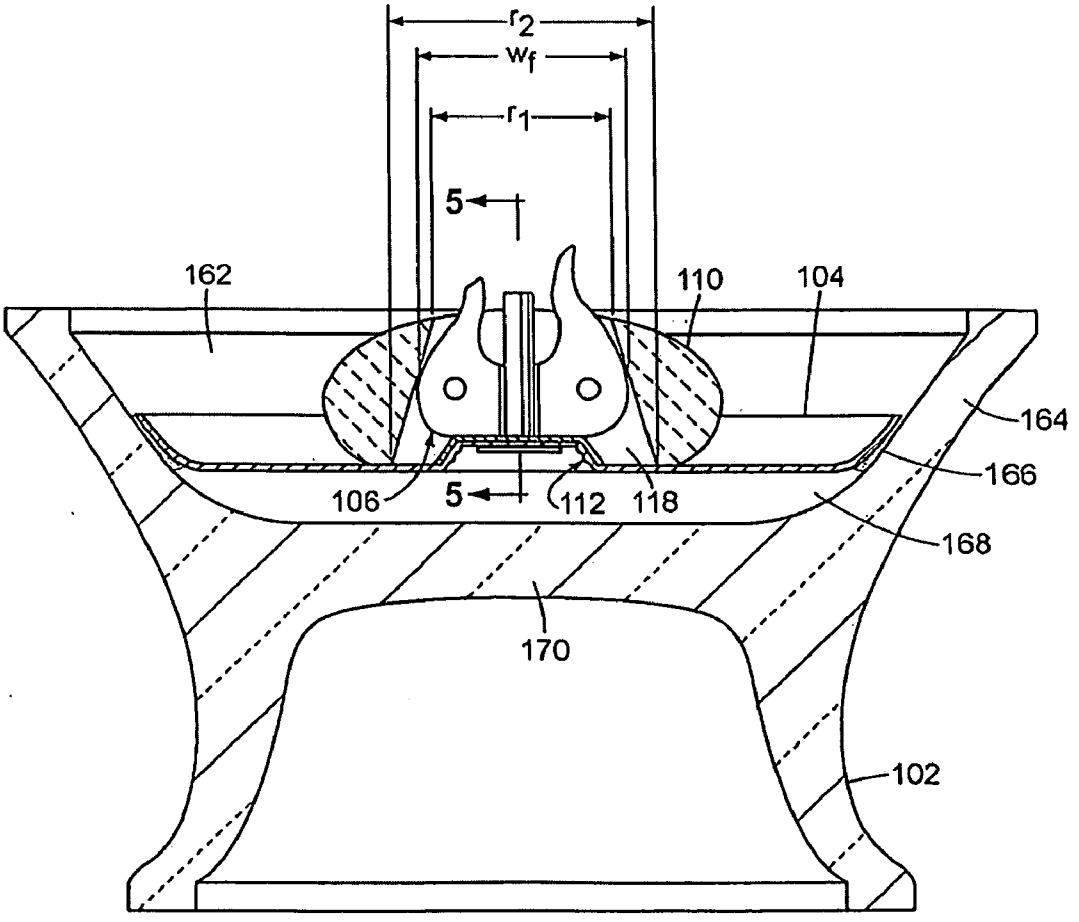
r2
Wf
r1
5
162
110
104
164
166
106
5
112
118
168
170
102

FIG. 4

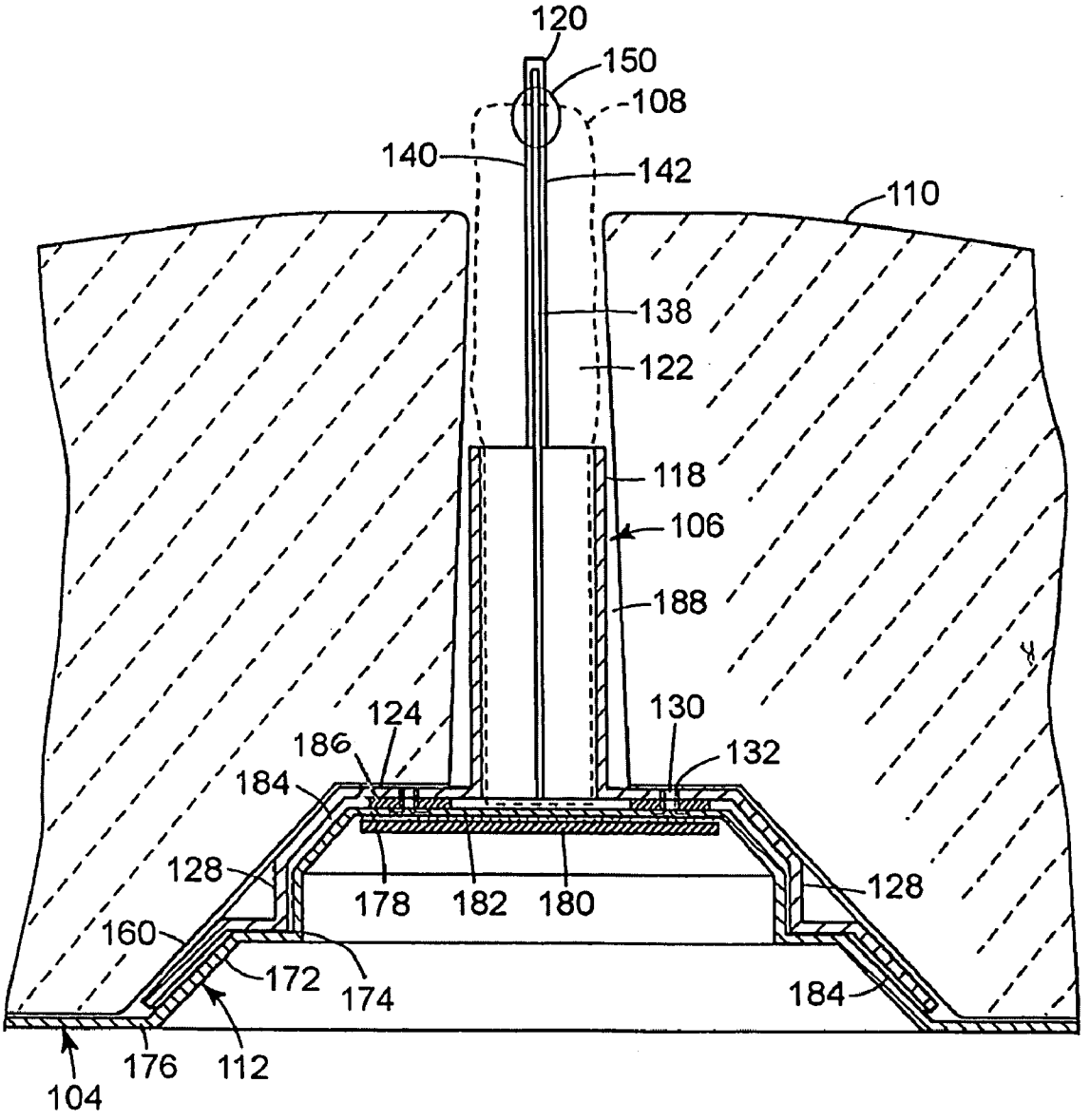
120
150
108
140
142
110
138
122
118
106
188
124
130
186
132
184
128
178
182
180
128
160
172
174
184
176
112
104

FIG. 5

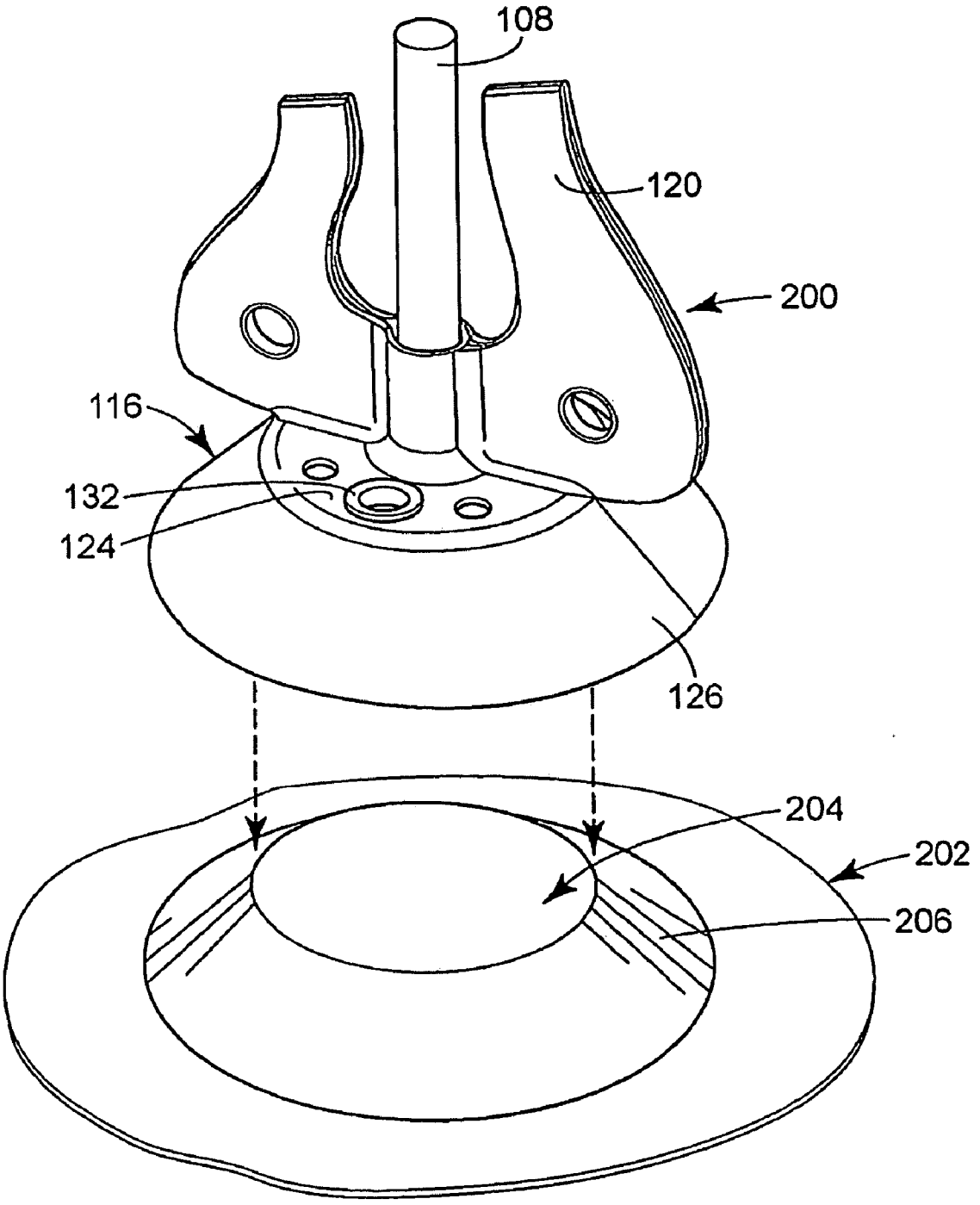

FIG. 6

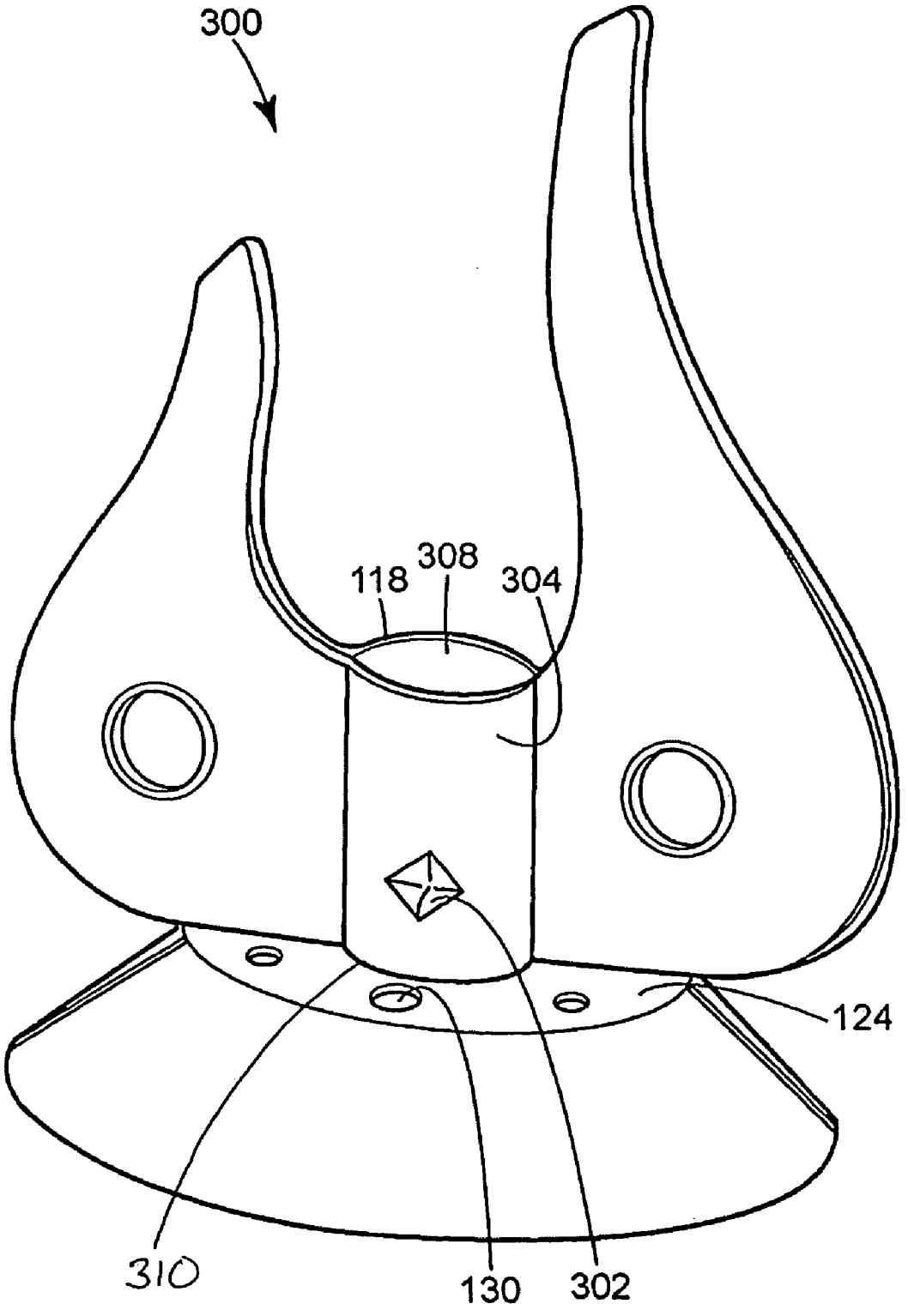

FIG. 7

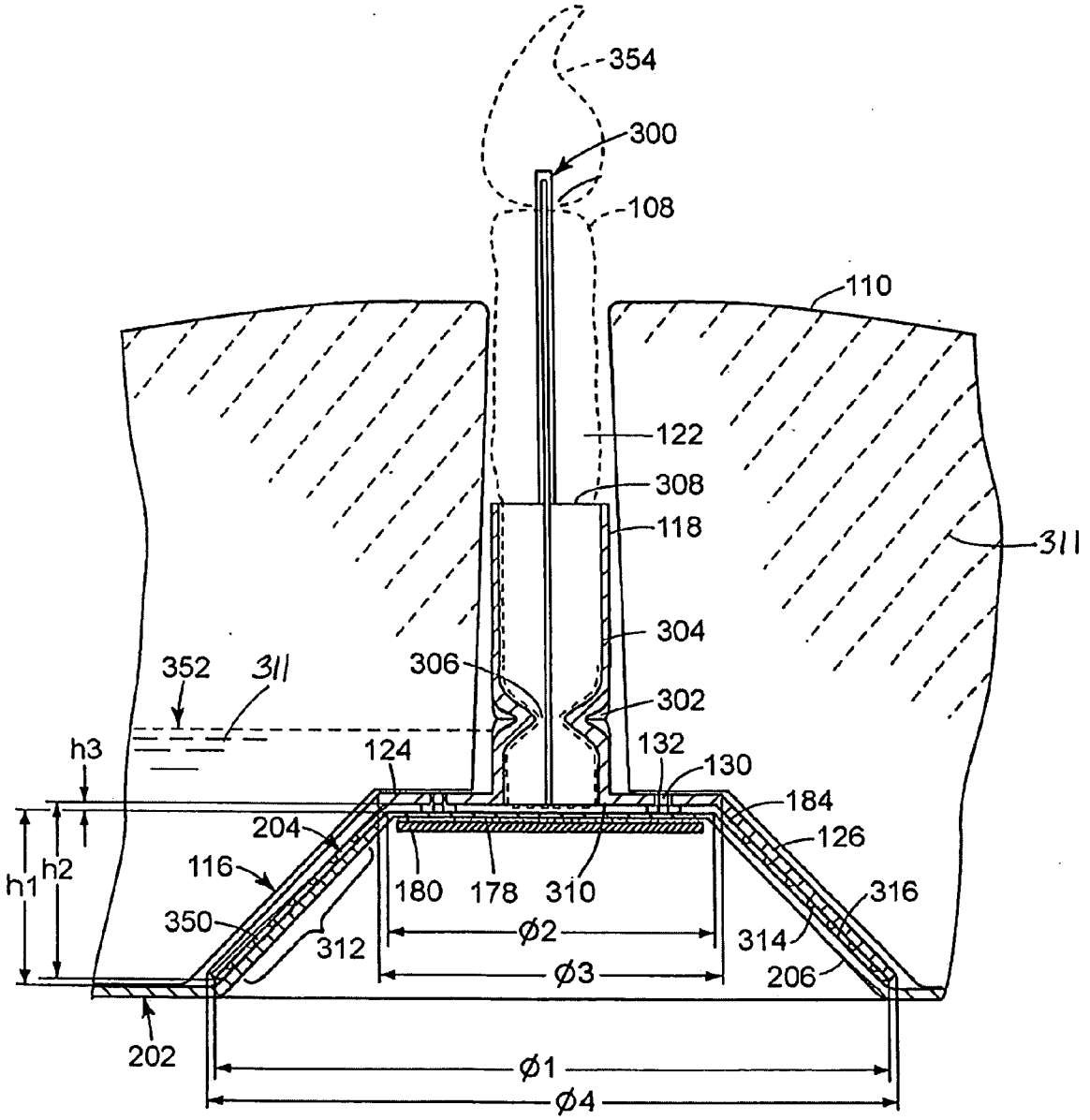
354
300
108
110
122
308
118
311
304
306
352
311
302
h3
124
132
130
184
204
126
h1
h2
116
180
178
310
316
350
Ø2
312
314
Ø3
206
202
Ø1
Ø4

FIG. 8

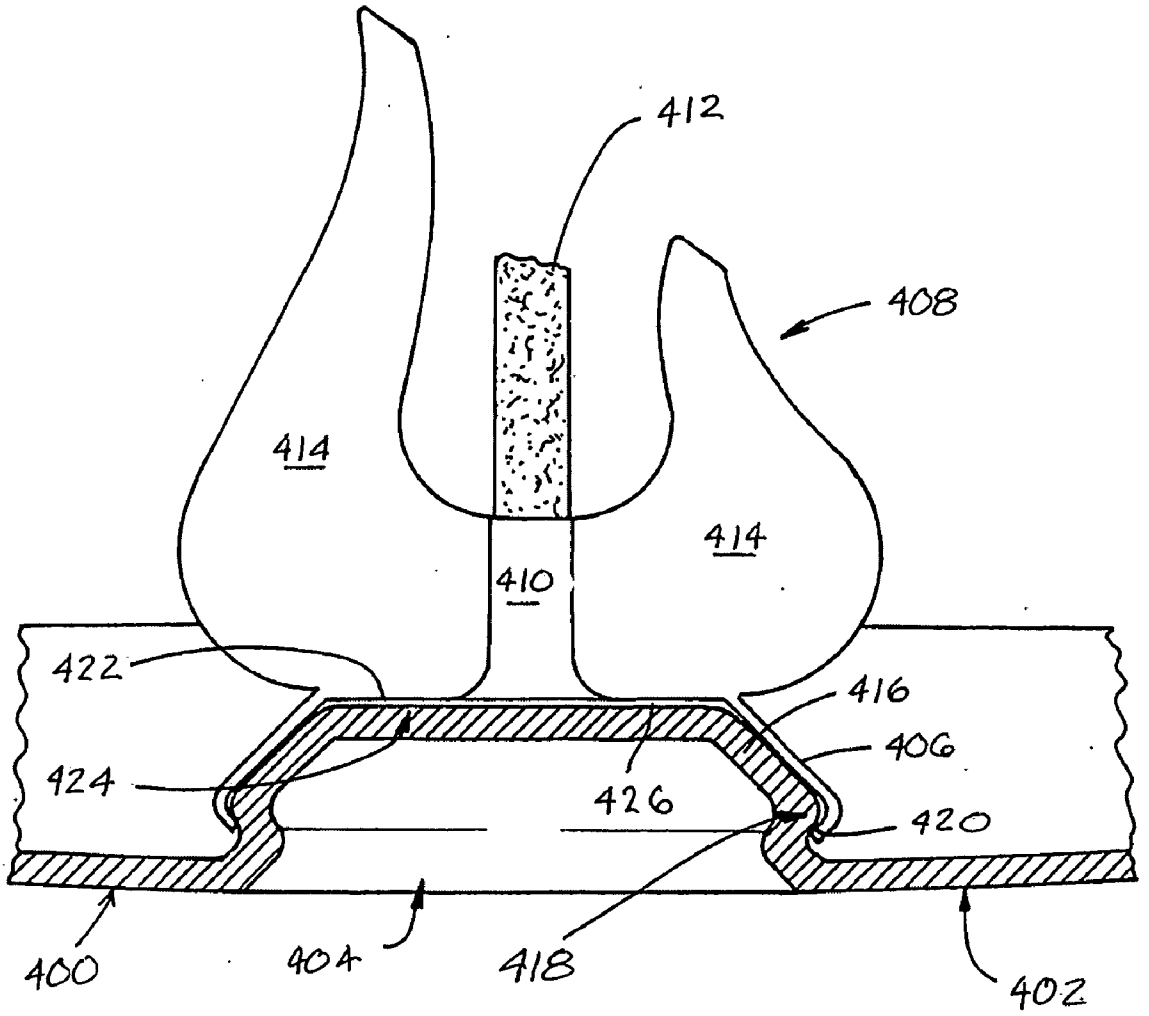

FIG. 9

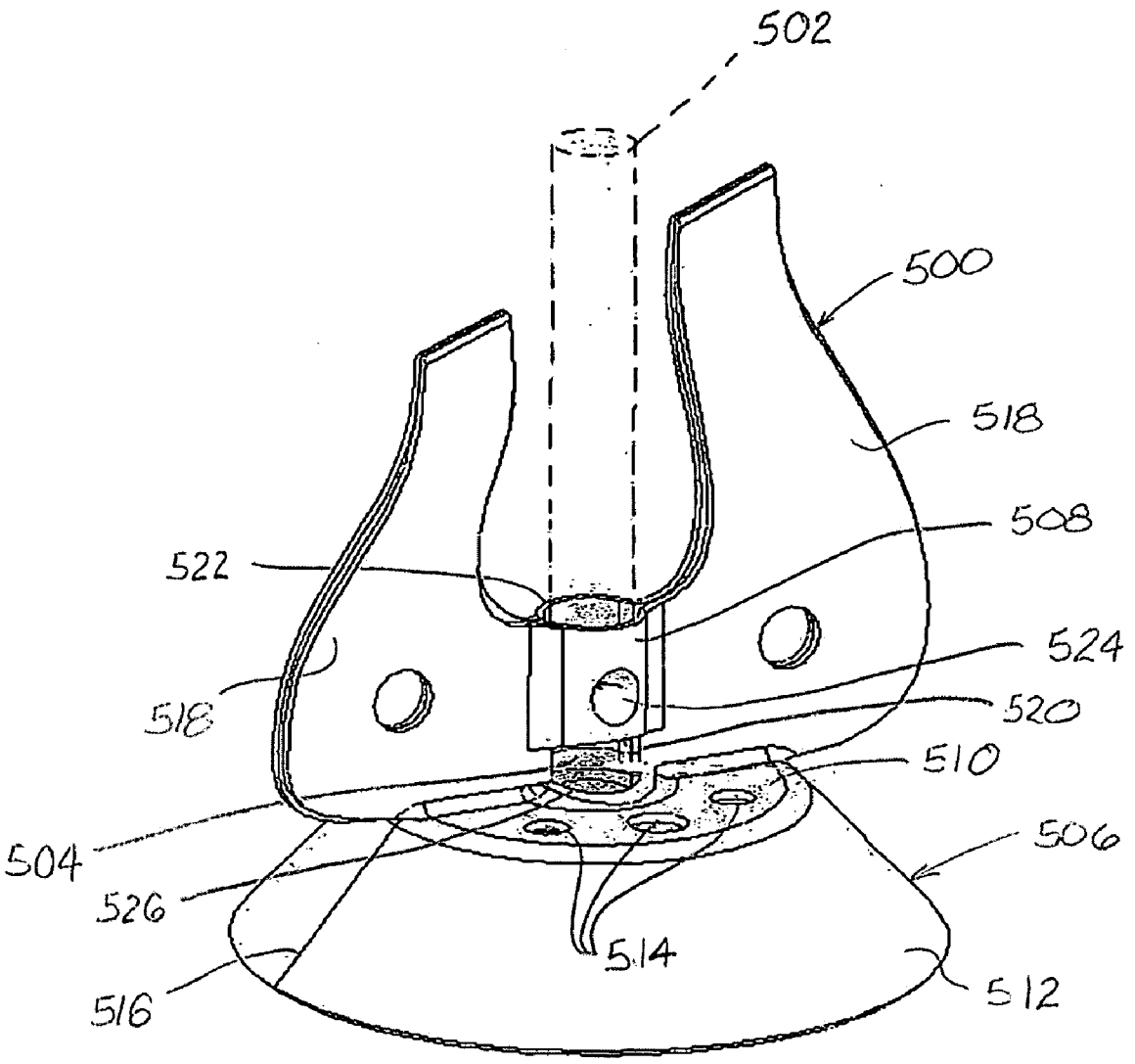

FIG. 10

WICK HOLDER

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation-in-part of U.S. patent application Ser. Nos. 11/123,461, 11/124,313, and 11/123,372, each of which was filed May 6, 2005, and each of which is a continuation-in-part of U.S. patent application Ser. No. 10/978,744, filed Nov. 1, 2004, which is a continuation-in-part of U.S. patent application Ser. No. 10/938,434, filed Sep. 10, 2004. This application is also a continuation-in-part of U.S. patent application Ser. No. 10/938,453, filed Sep. 10, 2004.

REFERENCE REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not applicable

SEQUENTIAL LISTING

[0003] Not applicable

BACKGROUND OF THE INVENTION

[0004] 1. Field of the Invention

[0005] The present invention relates to a wick holder for holding a wick in a candle assembly.

[0006] 2. Description of the Background of the Invention

[0007] It is know in the candle art to have a wick holder for holding a wick in a predetermined position within a wax fuel charge or within a liquid fuel charge of a candle, a lamp, or other similar open flame lighting device. In one candle, a wick holder is spool-shaped and has a tubular barrel and radial heat fins extending transversely from opposite ends of the barrel. The barrel has open top and bottom ends and a wick disposed through the top end. The wick and wick holder assembly are disposed within a wax fuel charge, such that one set of heat fins is disposed at a bottom end of the fuel charge and the other set of heat fins is disposed near a top end of the fuel charge with the wick extending upwardly through the top end of the fuel charge. The wick holder is formed of heat transmissive material, such as metal, and the wick has a heat transmissive core so that heat from a flame on the wick is transferred downwardly through the core to the wick holder so as to melt the wax as the flame burns. Holes through the sidewall of the barrel disposed between the fins allow melted wax to flow from outside the barrel into the wick and subsequently up to the flame.

SUMMARY OF THE INVENTION

[0008] In one aspect of the invention, a wick holder includes a base portion defining a cavity on a first side thereof, a wick retainer disposed on a second side of the base portion opposite the first side, an opening through the base portion between the first side and the second side, and a fuel aperture disposed on the second side of the base portion. The fuel aperture is adjacent to the base portion, and the fuel aperture is spaced from the opening.

[0009] In another aspect of the invention, a wick holder includes a base portion adapted to form a capillary space above a capillary pedestal and a wick receiver disposed above the base portion and adapted to retain a wick. An opening through the base portion is adapted to provide fluid communication between the capillary space and a top side of the base portion. A fuel aperture is defined at least partly by the wick receiver. The fuel aperture is disposed above and adjacent to the base portion spaced from the opening. The fuel aperture is adapted to be in fluid communication with the capillary space, and the wick holder is adapted to hold a portion of the wick above a pool of liquefied fuel surrounding the capillary pedestal.

[0010] In yet another aspect of the invention, a wick assembly includes a wick and a wick holder. The wick holder includes a base portion, a heat fin extending upwardly from a top side of the base portion, and a wick receiver disposed above the top side of the base portion. The wick is carried by the wick receiver with the wick disposed above the base portion. A fluid path is defined through the base portion. The fluid path extends between a supply area of liquefied fuel below the base portion and the top side of the base portion. A second fluid path extends from the wick and is disposed above the base portion. The first fluid path is spaced from the second fluid path, and the first fluid path and the second fluid path provide fluid communication between the supply area and the wick.

[0011] Other aspects and advantages of the present invention will become apparent upon consideration of the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] **FIG. 1** is an exploded isometric view of a candle assembly according to one aspect of the present invention;

[0013] **FIG. 2** is an enlarged isometric view of a wick holder shown in **FIG. 1**;

[0014] **FIG. 3** is a cross-sectional view of a fuel element along the line **3-3** of **FIG. 1**;

[0015] **FIG. 4** is a cross-sectional view generally transverse to line **3-3** of **FIG. 1** with the candle assembly in assembled form;

[0016] **FIG. 5** is an enlarged partial cross-sectional view along the line **5-5** of **FIG. 4**;

[0017] **FIG. 6** is an enlarged isometric view of a wick holder and a portion of a melting plate according to another aspect of the invention;

[0018] **FIG. 7** is an isometric view of still another wick holder according to the present invention;

[0019] **FIG. 8** is an enlarged cross-sectional view of the wick holder shown in **FIG. 7** in a similar view as shown in **FIG. 5**;

[0020] **FIG. 9** is a simplified partial cross-sectional view of a melting plate candle showing a capillary pedestal and locking wick holder with fins according to a further aspect of the invention; and

[0021] **FIG. 10** is an isometric view of a wick holder according to yet another aspect of the invention.

DETAILED DESCRIPTION

[0022] Referring now to **FIGS. 1-5**, a candle assembly **100** includes a support base **102**, a melting plate **104**, a wick holder **106**, a wick **108**, and a fuel element **110**. The support

base **102** carries the melting plate **104**, which is generally saucer shaped, and includes a centrally disposed capillary pedestal **112**. Optional decorative etchings **114** are disposed on an upper exposed surface of the melting plate **104** to provide enhanced attractiveness or visual information. The wick holder **106** includes a base portion **116** that fits over the capillary pedestal **112**, a wick retainer sleeve in the shape of an elongate cylindrical tube, or barrel **118**, and heat conductive elements, such as fins **120**. The barrel **118** receives the wick **108** therein such that the wick extends from the base portion **116** with a portion of the wick exposed above the barrel. The fuel element **110** is disposed over and around the wick holder **106** and includes a duct or slot **122** through which the wick **108** extends. The slot **122** has a width w_1 sufficient to allow the wick **108** to extend through the slot and a length l_1 sufficient to accept at least a portion of the fins **120** therethrough. In one embodiment, the fuel element **110** has a mass of wax approximately 15 grams, and the melting plate candle **100** may burn continuously for about 3 to 3½ hours on a single fuel element, such as the wax fuel element **110**, before the fuel is completely consumed.

[**0023**] As seen in **FIG. 2**, the base portion **116** of the wick holder **106** includes an end plate **124** encompassed by a generally conical base skirt **126**, and an upper portion including the barrel **118** extending upwardly from the end plate **124** and the fins **120** extending from the barrel and end plate. The base portion **116** is adapted to fit closely over and around the capillary pedestal **112** such that the barrel **118** is maintained in an upright, or substantially vertical, orientation when placed on the capillary pedestal. The base skirt **126** includes indentations or spacers **128**, and holes **130** extend through the end plate **124**. Ferromagnetic structures, such as steel rivets **132** or magnets **180** (shown in **FIG. 5**), are secured to the base portion **116**, such as through the holes **130**, so that the wick holder **106** may be releasably secured over the capillary pedestal **112** by magnetic forces. The barrel **118** is sized to receive the wick **108** with either a close fit or interference fit so as to retain the wick therein and define an opening **134** in the end plate **124** such that the wick can extend through the end plate. The fins **120** extend laterally outwardly on opposite sides of the barrel **118** and extend upwardly above the barrel. In one embodiment, the fins **120** are shaped to simulate a flame outline. In other embodiments, the fins **120** may have square, circular, oval, triangular, or other non-geometric shapes, and in still other embodiments, the fins **120** may have insulated areas (not shown) as described more fully in U.S. patent application Ser. No. 10/939,039, filed Sep. 10, 2004, and incorporated herein by reference in its entirety. The fins **120** are relatively thin strips of heat conductive material, such as metal, for transmitting heat from a flame burning on the wick **108** outwardly toward the fuel element **110**. In one embodiment, the wick holder **106** is formed from a single sheet of aluminum that is cut and folded about a fold **136** and thereby forming a capillary space **138** between two sides **140** and **142** and channels or gaps **144** in the base skirt **126**. In other embodiments, the wick holder **106** may be formed by other methods from other heat resistant materials, such as ceramic, other metals, heat resistant plastics, etc. If the wick holder **106** is formed of a ferromagnetic material, such as steel, the steel rivets **132** may optionally be omitted. The two sides **140** and **142** are secured together by any convenient means, such as with rivets **146** through holes **148** in the heat fins **120**, welds, clips, heat resistant adhesives, etc. The gaps **144** and the holes **130** allow melted fuel material from the fuel element **110**, to drip or seep underneath the base skirt **126**, and the capillary space **138** allows melted fuel material to traverse up the fins **120** by capillary action and thereby provide a source of fuel material in non-consumable wick areas **150**. An example of such capillary action is described in U.S. patent application Ser. No. 10/938,453.

[**0024**] As seen in detail in **FIG. 3**, the fuel element **110** includes a body **152** of fuel material and has an upper surface **154** and a lower surface **156**. The fuel element **110** in one embodiment is shaped as a wax puck and in other embodiments may have other shapes and/or include other meltable or flowable fuel materials, such as paraffin or animal fat, having a solid or semi-solid state or otherwise maintainable in a fixed form at room temperature. The lower surface **156** of the fuel element **110** defines a cavity **158** having an upper cavity wall **160** shaped to conform to the base portion **116** of the wick holder **106**. The slot **122** extends from the upper surface **154** to the upper cavity wall **160** and has a width w_1 at the upper surface that is smaller than a width w_2 at the cavity wall. The width w_1 is adapted to prevent melted wax from the fuel element **110** from falling or trickling down the slot **122** without engaging the wick **108**, or put another way, the width w_1 is narrow enough to ensure that melted fuel material from near the upper portion of the slot **122** will engage the wick **108** as it falls or trickles down the slot. In one embodiment, the width w_1 is not more than approximately 0.02" (0.5 mm) larger than a diameter of the wick at an upper end of the slot **122**. In another embodiment, the width w_1 is approximately the same as a diameter of the wick **108**. In yet another embodiment, the width w_1 is less than a width of the wick **108** so that an interference fit exists between the wick and the body **152** at the upper end of the slot **122**. In a further embodiment, the width w_1 is less than or equal to approximately 0.12 inches (3 mm), and the wick **108** has a diameter of approximately 0.1 inches (2.5 mm). In yet a further embodiment (not shown), the slot **122** may have a width that is initially more than approximately 0.02 inches (0.5 mm) larger than a diameter of the wick **108** to allow for easy insertion of the wick **108** and wick holder **106** into the slot **122**, and the slot is filled subsequently with additional fuel material in a second manufacturing step so that the width w_1 is less than approximately 0.02 inches (0.5 mm) larger than the diameter of the wick.

[**0025**] As shown in **FIG. 4**, the support base **102** carries the melting plate **104** within an upper chamber **162**, which is generally bowl-shaped. The melting plate **104** in one embodiment is secured to a sidewall **164** of the upper chamber **162** with adhesive **166** thereby providing an empty air space **168** between the melting plate and an intermediate wall **170** of the support base **102**. The air space **168** provides additional insulation between the melting plate and the support base **102** to reduce heat loss through the melting plate to the support base. In another embodiment (not shown) the melting plate **104** is adjacent to the intermediate wall **170** with adhesive **166** placed therebetween such that no air space **168** is disposed between melting plate and the intermediate wall. Of course, other arrangements and support configurations for the melting plate **104** are also suitable for supporting the melting plate **104**.

[**0026**] In one embodiment of the fuel element **110**, the slot **122** has a length l_1 in the upper surface **154** that is longer

than a length l_2 in the lower surface **156**. The length l_1 is shorter than a largest width w_f of the fins **120** and the length l_2 is longer than the largest width w_f of the heat fins. Such a configuration of the slot lengths l_1 and l_2 in relation to the width w_f, in addition to the slot widths w_1 and w_2 as described herein above, facilitates inserting the wick holder **106** fully into the slot from the lower surface **156**. Such configuration of the slot **122** and cavity **158** may also prevent the slot from fully receiving the wick holder if the fins **120** are inserted into the slot through the upper surface **154** rather than through the lower surface **156**, thereby preventing or discouraging improper assembly of the fuel element **110** and the wick holder **106**.

[0027] As illustrated in **FIG. 5**, a portion of the melting plate **104**, capillary pedestal **112**, wick holder **106**, fuel element **110**, and wick **108** are shown assembled and ready for use or initial ignition by a user. In one embodiment, the capillary pedestal **112** includes an inclined sidewall **172** having an annular groove **174** extending therearound in a medial position between a floor **176** of the melting plate **104** and a top wall **178** of the capillary pedestal. A magnet **180** is secured to an underside of the top wall **166** with an adhesive **182**. In another embodiment, the magnet **180** may be disposed on an upper side of the top wall **178** or at another location sufficient to attract the wick holder **106**. The spacers **128** are adapted to seat in the annular groove **174** to provide a capillary space **184** between the base skirt **126** and the inclined sidewall **172**. The capillary space **184** is sized to facilitate capillary movement of melted or liquid fuel material (not shown) toward the wick **108**. The spacers **128** also help retain the wick holder **106** on the capillary pedestal **112** by seating in the annular groove **174**. In addition, the steel rivet **132** in the wick holder **106** is attracted to the magnet **180** when placed over the capillary pedestal **112** and thereby prevents the wick holder from accidentally falling or slipping off of the capillary pedestal. When placed on an underside of the end plate **124**, the steel rivets **132** also act as spacers to help maintain the capillary space **184**. In another embodiment, one or more magnets **186** may be secured to the end plate **124** by any convenient means, such as with an adhesive or by a rivet, in order to maintain the wick clip **106** in position on the capillary pedestal **112**. The cavity wall **160** of the fuel element **110** is shaped to fit around the base skirt **126** and barrel **118** of the wick holder **106** and rest on the floor **176** of the melting plate **104** in order to minimize open space **188** between the fuel element and the wick **108**, the wick holder **106**, and the melting plate floor **176**. Optimizing and/or minimizing the open space **188** increases the likelihood of having melted fuel material (not shown) being fed directly to the wick **108** rather than falling downwardly to the floor **176** or accumulating in the open space and thereby potentially starving the wick of liquid or melted fuel material while burning. However, as the melted fuel material accumulates about the base of the capillary pedestal **112**, whether due to melting from the melting plate **104** or from direct melting by a flame **109** disposed on the wick **108**, the melted fuel material is drawn upwardly along the capillary space **184** by capillary action toward non-consumable wick areas **150** while the candle is burning. The wick **108** in one embodiment extends through the open end **134** of the barrel **118** to touch or nearly touch the top wall **178** of the capillary pedestal **112** so that liquid fuel material drawn up the capillary space **184** will engage the wick **108** and be drawn upwardly therein for eventual burning by a flame burning on the wick. The wick barrel **118** has an inside diameter sufficient to receive the wick **108**. The inside diameter of the barrel **118** may be larger, smaller, or the same as the diameter of the wick and may be uniform or have different diameters along a length thereof. In one embodiment, the inside diameter of the barrel **118** is larger than the diameter of the wick **108** so that the wick may be easily inserted into the barrel. In another embodiment, the inside diameter of the barrel **118** is uniform and approximately 0.012" (0.3 mm) larger than the diameter of the wick **108**. In yet other embodiments, the inside diameter of the barrel **118** is the same size as or smaller than the wick **108**. Melted fuel material can seep into the capillary space **184** through the weep holes **130** and thereby prime or facilitate capillary action upward through the capillary space **184**. Melted fuel material may also be drawn upwardly in the capillary space **138** between opposing sides **140**, **142** of the fins **120** and drawn to the non-combustible wick areas **150** where the melted fuel material is vaporized and ignited by a flame disposed on the wick **108**.

[0028] Turning now to **FIG. 6**, another wick holder **200** and melting plate **202** are shown that are similar to the wick holder **106** and melting plate **104** shown in **FIGS. 1-5**, except that a capillary pedestal **204** includes a smooth inclined sidewall **206** without the annular groove **174**. The wick holder **200** also does not include the spacers **128** in the base skirt **126**. A capillary space (not shown), similar to **184**, is maintained between the base skirt **126** and the sidewall **206** by steel rivets **132** protruding below an end wall, such as **124**, of a base portion **116** of the wick holder **200**. In this embodiment, the wick holder **200** is maintained on the capillary pedestal **204** substantially by the attraction between the steel rivets **132** and the magnet **180** (shown in **FIG. 5**) in the capillary pedestal and any weight of the fuel element **110**.

[0029] In **FIGS. 7 and 8**, a wick holder **300** of another embodiment for use in a candle assembly, such as **100**, is similar to the wick holder **106** (or **200**) except that the wick holder **300** also includes a medial portion of the barrel **118** having a cross-sectional area that is less than a cross-sectional area of any other portion of the wick barrel. An indentation **302** in a sidewall **304** of the barrel **118** defines a constricted portion **306** of the barrel disposed intermediate opposite open ends **308** and **310** of the barrel and having a cross-sectional area less than any other portion of the barrel. The wick **108** extends through the barrel **118** such that a portion or end of the wick adapted to absorb fuel material **311** (when in a melted or otherwise fluid state) extends downwardly through the end **310** and another portion or end of the wick adapted for ignition extends upwardly through end **308**. The constricted portion **306** reduces an effective wick cross-sectional area, and thereby may reduce or restrict a capillary fluid flow capacity of the wick between the first open end **308** and the second open end **310**. The restricted flow capacity, and subsequently reduced volume flow rate, of the fluid fuel material **311** up the wick **108** from the end **310** toward a flame region above the end **308**, in turn may reduce the fuel material burn rate and extend the life of the fuel element **110**. Because the constricted portion **306** having a larger cross-sectional area allows a faster volume flow rate, or increased capillary fluid flow capacity, than a constricted portion having a smaller cross-sectional area, the capillary fluid flow capacity of the wick **108** may be substantially reduced by reducing the cross-sectional area of the

constricted portion. Such a constriction on the flow rate of the fluid fuel material **311** upwardly along the wick **108** past the constricted portion **306** is enhanced when the sidewall **304** is substantially liquid impervious (e.g., does not allow the fluid fuel material to pass therethrough to the wick **108**), which thereby restricts the flow of the fluid fuel material into the wick through the end **310** located in the end plate **124** or above the end **308** of the barrel **118**. The indentation **302** may also help maintain the wick **108** in a predetermined position within the barrel **118** such that, for example, an end portion of the wick extends through or to the end **310** in order to prevent the wick from being pulled out of the barrel and thus potentially losing contact with the flow of the fluid fuel material **311** toward the wick through the capillary space **184** and weep holes **130**.

[**0030**] Other variations and embodiments of the candle assembly and wick holder **300** described in detail herein are also specifically contemplated. For example, in one embodiment, the barrel **118** may take the form of a sleeve having a cylindrical shape or a tubular shape having other cross-sectional areas and shapes (not shown). In another embodiment, the constricted portion **306** in the barrel **118** is formed by an inner annular ridge (not shown), which may be formed by indenting or crimping the sidewall **304** entirely around the wick barrel **118** or by an inner annular shoulder (not shown) disposed on an inner surface of the sidewall **304**. The constricted portion **306** in another embodiment may be formed by a single indentation **302** or by a plurality of indentations, which may be either in opposing relationship or offset from each other. In another embodiment (not shown) the barrel **118** may have the form of a wick casing that is not generally tubular, but rather includes a longitudinally curved sidewall that encases a portion of the wick **108** and has first and second openings in the sidewall through which the wick extends.

[**0031**] In another aspect of the present invention, which is shown in **FIG. 8** but which is also applicable to any combination of any of the wick holders and any of the capillary pedestals described herein, the capillary space **184** defines a volume, or capillary well **350**, between the base portion **116** of the wick holder **300** and the capillary pedestal **204**. The capillary well **350** has dimensions that are preselected to promote a successful sustained relight of the wick **108** after a pool **352** (shown in dashed lines) of the fuel material **311** (such as wax or other meltable fuel) has been formed in melting plate **202** around the peripheral skirt **126** and capillary pedestal **204** and then allowed to solidify. During a sustained burn, a fluid portion of the fuel material **311** from the pool **352** is drawn into the capillary well **350** and up to the wick **108** by capillary action to feed a flame **354** at wick **108**. If the flame **354** is extinguished prior to consuming the entire fuel element **110**, the pool **352** of fuel material **311** solidifies and extends across the bottom of the melting plate **202**, through the capillary well **350**, and into the wick **108**. In one embodiment, when the wick **108** is re-lit after the pool **352** of fuel material **311** has solidified, the capillary space **184** is dimensioned such that a fluid supply of the fuel material is quickly formed and available in the capillary well **350** to feed the flame **354** via the wick **108** until the fuel material surrounding the peripheral skirt **126** has melted sufficiently to provide a supply of liquefied fuel material to replace the fuel material in the capillary well. For example, if the capillary space **184** is dimensioned too small, there may not be enough fuel material in the capillary well **350** to sustain the flame **354** on the wick **108** during a sustained relight before the pool **352** of fuel material **311** surrounding the peripheral skirt **126** has melted enough to provide additional liquefied fuel to the wick **108**. Also, for example, if the capillary space **184** is too large, heat transfer through the solidified fuel material **311** in the capillary well **350** may be too slow to melt enough of the fuel material therein to provide liquefied fuel to the wick **108** before fuel material in the wick is burned. Under either circumstance, the flame **354** may run out of fuel and extinguish prior to melting a sufficient amount of the fuel material **311** in the pool **352** to begin or sustain substantially continuous capillary movement of the fluid fuel material from outside of the capillary space **184**, into the capillary well **350**, and up the wick **108** to feed the flame **354**. Therefore, to assist in a successful sustained relight of the wick **108** in one embodiment, the capillary well **350** has a volume not less than a volume sufficient to provide an amount of melted fuel to the relit wick **108** until a sufficient amount of liquefied fuel is formed from the pool **352** of solidified fuel material **311** adjacent to or surrounding the peripheral skirt **126** to continuously feed the flame **354** by capillary action through the capillary space **184**. In another embodiment, the volume of the capillary well **350** is not more than a volume able to allow heat from the flame **354** to melt the solidified fuel material **311** disposed in the capillary space **184** sufficiently rapidly to feed the flame **354** after solidified fuel material **311** carried in the wick is burned.

[**0032**] In a further embodiment, a successful relight can be achieved if the volume of the capillary well **350** is proportional to a thermal mass of an entire candle assembly, such as **100**, in order to provide a sufficient source of melted fuel to the wick until the pool **352** of solidified wax has melted sufficiently to provide an adequate flow of fuel to the wick **108** to maintain a sustained burn of the flame **354**. The thermal mass of the candle assembly **100** is a measure of the amount of energy needed to change the temperature of the entire melting plate candle by a measured amount and is equal to the sum of the products of the mass of each portion of the candle assembly multiplied by the specific heat of that portion. Illustratively, a successful relight may be achieved when the ratio of the volume of the capillary well **350** to the thermal mass of the entire candle assembly is between about 0.00006 cubic inches per calorie per degree centigrade (hereinafter, in^3/cal/° C.) (1 mm^3/cal/° C.) and about 0.0006 in^3/cal/° C. (10 mm^3/cal/° C.), or between about 0.0001 in^3/cal/° C. (2 mm^3/cal/° C.) and about 0.0004 in^3/cal/° C. (6 mm^3/cal/° C.), or between about 0.00018 in^3/cal/° C. (3 mm^3/cal/° C.) and about 0.00024 in^3/cal/° C. (4 mm^3/cal/° C.). Accordingly, in one embodiment, the thermal mass of the candle assembly is between about 135 cal/° C. and about 10 cal/° C., or between about 75 cal/° C. and about 40 cal/° C., or between about 61 cal/° C. and about 50 cal/° C., and the volume of the capillary well **350** is between about 0.006 in^3 (100 mm^3) and about 0.03 in^3 (500 mm^3), or between about 0.009 in^3 (150 mm^3) and about 0.018 in^3 (300 mm^3), or about 0.012 in^3 (200 mm^3).

[**0033**] For example, the thermal mass of an embodiment of a candle assembly, such as **100**, includes the support base **102**, the melting plate **202**, and the wick holder **300** having a combined thermal mass of about 50 cal/° C. and the fuel element **110** of approximately 0.53 oz. (15 g) of wax having a thermal mass of about 10.5 cal/° C. before being burned.

The capillary pedestal **204** has a generally frustoconical shape with a height h**1** between about 0.39 inches (10 mm) and about 0.04 inches (1 mm), or about 0.2 inches (5 mm), a bottom radius Φ**1** between about 1.18 inches (30 mm) and about 0.39 inches (10 mm), or about 0.83 inches (21 mm), and a top radius Φ**2** between about 0.04 inches (1 mm) and about 0.79 inches (20 mm), or about 0.43 inches (11 mm). The base **116** has a frustoconical shape generally complementary to the capillary pedestal with the peripheral skirt **126** having an upper diameter Φ**3** of between about 0.08 inches (2 mm) and about 0.83 inches (21 mm), or between about 0.43 inches (11 mm) and about 0.55 inches (14 mm), or about 0.51 inches (13 mm); a bottom diameter Φ**4** between about 1.22 inches (31 mm) and about 0.43 inches (11 mm), or about 0.79 inches (20 mm) and about 0.91 inches (23 mm), or about 0.87 inches (22 mm); a height h**2** between about 0.43 inches (11 mm) and about 0.08 inches (2 mm), or between about 0.28 inches (7 mm) and about 0.16 inches (4 mm), or about 0.2 inches (5 mm); and a height h**3** of the rivets **132** from the end plate **124** of between about 0.004 inches (0.1 mm) and about 0.04 inches (1 mm), or between about 0.03 inches (0.8 mm) and about 0.02 inches (0.5 mm), or about 0.02 inches (0.6 mm). In another embodiment, the capillary pedestal **204** has a height h**1** about 0.18 inches (4.7 mm), a bottom radius Φ**1** about 0.81 inches (20.5 mm), a top radius Φ**2** about 0.44 inches (11.1 mm), and the base **126** has a skirt **126** having an upper diameter Φ**3** about 0.5 inches (12.6 mm), a bottom diameter Φ**4** about 0.85 inches (21.6 mm), and a height h**2** about 0.2 inches (5.05 mm). When the base **116** is placed on top of the capillary pedestal **204**, the end plate **124** is a perpendicular distance of about 0.03 inches (0.65 mm) from a top wall **178** of the capillary pedestal, and the peripheral skirt **126** is perpendicular distance of about 0.02 inches (0.38 mm) from the sidewall **206**, which defines a capillary well **350** having a volume of approximately 0.012 in^3 (200 mm^3).

[**0034**] **FIG. 9** illustrates a portion of a melting plate **400** comprising a concave base **402**, and having a raised pedestal or protrusion **404** located near the center thereof. The pedestal is shaped so as to engage the legs or skirt **406** of a wick holder **408**. The wick holder **408** has a central retention mechanism, such as a body **410**, which holds a wick **412**, and heat fins **414** located so as to absorb heat from a flame upon the wick mounted in the wick holder, and to permit flow of the heat from the flame to the base **402** of the melting plate **400**. The legs or skirt **406** of the wick holder fit in close proximity to the sides **416** of the pedestal **404** and engage an undercut **418** in a side surface of the pedestal by means of shoulder **420** in such a manner as to resist removal therefrom. The legs or skirt **406** and a base **422** of the wick holder **408** and the sides **416** and top **424** of the pedestal **404** are in close proximity, so as to permit maximum heat exchange when a flame is disposed on the wick **412**, and so as to create a capillary gap **426** resulting in a capillary flow of melted wax from the bottom of the melting plate to the top of the pedestal **424**. The bottom **422** of the wick holder is thus in close proximity to the top **424** of the pedestal **404**, promoting a rapid and even flow of liquefied fuel to the wick **412**, but held in position so as to contact the fuel by the wick holder. Although the embodiment is illustrated in terms of a melting plate candle, it may be equally as effective in the context of a candle jar, tea light, or votive holder.

[**0035**] In **FIG. 10**, another wick holder **500** according to the present invention is adapted for use with a candle assembly similar to **100** having a capillary pedestal (not shown) so as to create a capillary space between the wick holder and the capillary pedestal through which liquefied fuel (not shown), such as oil or melted wax, may be drawn from a pool, upwardly between the capillary pedestal and the wick holder, toward a wick **502**, which is disposed above the capillary pedestal. The wick holder **500** is generally similar to other wick holders described herein, such as the wick holder **106**, the wick holder **200**, the wick holder **300**, and the wick holder **408**, except that capillary flow of the liquefied fuel to the wick **502** is diverted across a portion of the wick holder and laterally through a side aperture, or fuel feed opening **504**, into the wick above the top of a base portion **506** rather than flowing directly into the bottom end of the wick through a hole in the bottom or base portion as generally shown in the other embodiments disclosed herein. In general, the base portion **506** of the wick holder **500** defines a bottom cavity (not shown) on an opposite side of the base portion from a wick receiver **508**. The bottom cavity is shaped so as to conform closely about a capillary pedestal, such as the capillary pedestal **204**, **112**, or **404**, in order to promote the upward capillary flow of the liquefied fuel. In this particular embodiment, the base portion **506** has a top wall or top plate **510** and a generally frustoconical capillary skirt **512** depending downwardly from an outer periphery thereof, which, together, define the bottom cavity. When placed in an operative position on a capillary pedestal, the capillary skirt **512** is disposed around the sidewall of the capillary pedestal, and the top plate **510** is disposed above a flat top end of the capillary pedestal thereby forming the capillary space. The base portion **506**, in other embodiments, may have different shapes according to the shape of the capillary pedestal. The top plate **510** and the capillary skirt **512** are generally formed of a sheet of metal that is liquid impervious except for one or more openings, such as holes **514** through the top plate and/or a gap **516** along a seam of the wick holder **500**. The holes **514** are disposed generally around an outer circumferential portion of the top plate **510**. Heat fins **518** extend upwardly from the top plate **510** and carry the wick receiver **508**, which in this embodiment is a generally cylindrical barrel, therebetween for holding the wick **502** therein. The wick receiver **508** is generally disposed over a central portion of the top plate **510** such that the wick **502** extends downwardly through a lower open end **520** and rests on top of the central portion of the top plate disposed radially between and spaced from the holes **514**. A portion of the wick **502** for carrying a flame thereon extends upwardly through an upper open end **522** of the wick receiver **508**, which is distal from the base portion **506**. An indentation **524** in the wick receiver **508** serves to help retain the wick **502** therein and may also serve to control the rate of capillary flow upwardly along the wick as described above in relation to the indentations **302** in the wick holder **300**. Unlike the previously described wick holders, the area of the top plate **510** directly beneath a bottom end **526** of the wick **502** is not open to the capillary space under the base portion **506**.

[**0036**] In operation, the wick holder **500** is disposed on a capillary pedestal in a melting plate candle assembly (similarly as described with regard to the melting plate candle **100**) such that when a flame is burning at a top end of the wick **502**, liquefied fuel, such as melted wax, from a fuel element is drawn upwardly toward the wick to feed the flame even when a level of the liquefied fuel drops below the

elevation of the top plate **510** and the bottom end **526** of the wick. The fuel feed opening **504** is in fluid communication with the capillary space via the holes **514**. In the present embodiment, the liquefied fuel is drawn upwardly from underneath the capillary skirt **512**, through the capillary space between the base portion **506** and the capillary pedestal, and through the holes **514** and possibly the gap **516**, across the top of the top plate **510**, and laterally into the wick **502** through the fuel feed opening **504**. As shown in **FIG. 10**, the fuel feed opening **504** is defined between the top plate **510** and the bottom end **520** of the cylindrical barrel; however, the fuel feed opening **504** may take the form of any opening adjacent to the base portion **506** that is sufficient to allow the liquefied fuel to be drawn laterally into the wick **502** above the base portion. For example, the fuel feed opening **504** may include one or more slits or small holes through the sidewall(s) of the wick receiver **508**, which would draw liquefied fuel across the top of the top plate **510** and laterally into the wick **502**. The lateral fuel flow into the wick **502** through the fuel feed opening **504** is sustained by the capillary forces of the wick **502** and attractive forces of the liquefied fuel so as to draw the liquefied fuel from the holes **514** across the top plate **510**, through the fuel feed opening, and into the wick. In other embodiments, the lateral fuel feed opening **504** may also be combined with a hole (not shown) in the top plate directly underneath the bottom end **526** of the wick **502**, which may be formed by, for example, the gap **516** extending across the top plate **510** or any other form of opening. Other features of the various wick holders described herein may also be combined with the wick holder **500** and vice-versa.

[**0037**] The invention having been described in an illustrative manner, it is understood that the terminology used is intended to be in the nature of description rather than of limitation. The various components of the various melting plate candle assemblies described herein may be packaged as an assembled unit, as an unassembled kit including all or a portion of the components, as individual components, and in any combination thereof. Different and various combinations of the above-mentioned components of the various melting plate candle assemblies can also be used in the apparatuses, methods, kits, and combinations herein described. Other variations, modifications, and equivalents of the present invention possible in light of the above teachings are specifically included within the scope of the impending claims.

INDUSTRIAL APPLICABILITY

[**0038**] A wick holder, according to the present invention, may be used to hold a wick in a predetermined location relative to a fuel element. In one particular application, the wick holder of the present invention may be used with a melting plate candle assembly as generally described herein to maintain a flame on the wick at a height above the level of a liquefied pool of fuel so as to prevent or at least minimize the risk of flash over in the pool of liquefied fuel. Other uses and benefits of the wick holder of the present invention will be apparent to those skilled in the art.

[**0039**] Numerous modifications to the present invention will be apparent to those skilled in the art in view of the foregoing description. Accordingly, this description is to be construed as illustrative only and is presented for the purpose of enabling those skilled in the art to make and use the invention and to teach the best mode of carrying out same. All patents and patent applications cited herein are incorporated by reference in their entireties. The exclusive rights to all modifications that come within the scope of the appended claims are reserved.

I claim:

1. A wick holder, comprising:

a base portion defining a cavity on a first side thereof;

a wick retainer disposed on a second side of the base portion opposite the first side;

an opening through the base portion between the first side and the second side; and

a fuel aperture disposed on the second side of the base portion, wherein the fuel aperture is adjacent to the base portion, and wherein the fuel aperture is spaced from the opening.

2. The wick holder of claim 1 further comprising a second aperture defined at an end of the wick retainer distal from the base portion, wherein the second aperture is adapted to allow a portion of a wick to extend therethrough for carrying a flame thereon.

3. The wick holder of claim 1, wherein a liquefied fuel travels over a portion of the second side of the base portion between the opening and the fuel aperture when a flame is disposed on a wick received by the wick retainer.

4. The wick holder of claim 3, wherein the base portion comprises a capillary skirt, the capillary skirt at least partly defining the cavity.

5. The wick holder of claim 4, wherein the wick retainer comprises a retainer sleeve.

6. The wick holder of claim 5, wherein the fuel aperture is at least partly defined between the base portion and the retainer sleeve.

7. The wick holder of claim 5, wherein the fuel aperture is disposed through a sidewall of the retainer sleeve.

8. The wick holder of claim 5 further comprising an indentation in a sidewall of the retainer sleeve.

9. The wick holder of claim 4, wherein the base portion comprises a top plate, and the capillary skirt depends from the top plate.

10. The wick holder of claim 9, wherein the opening is defined through the top plate.

11. The wick holder of claim 10 further comprising a heat fin extending from the second side of the base portion.

12. The wick holder of claim 11, wherein the heat fin is attached to the top plate and supports the wick retainer.

13. A wick holder, comprising:

a base portion adapted to form a capillary space above a capillary pedestal;

a wick receiver disposed above the base portion and adapted to retain a wick;

an opening through the base portion adapted to provide fluid communication between the capillary space and a top side of the base portion; and

a fuel aperture defined at least partly by the wick receiver, the fuel aperture disposed above and adjacent to the base portion spaced from the opening;

wherein the fuel aperture is adapted to be in fluid communication with the capillary space; and

wherein the wick holder is adapted to hold a portion of the wick above a pool of liquefied fuel surrounding the capillary pedestal.

14. The wick holder of claim 13, wherein the base portion comprises a top wall and a capillary skirt depending downwardly from the top wall, and wherein the opening is disposed through the top wall.

15. The wick holder of claim 14 further comprising a heat fin extending upwardly from the top wall, wherein the heat fin carries the wick receiver.

16. The wick holder of claim 15, wherein the fuel aperture is defined between the top wall and the wick receiver.

17. The wick holder of claim 16, wherein the wick receiver comprises a tubular retainer sleeve.

18. A wick assembly comprising a wick and a wick holder, the wick holder comprising:

a base portion;

a heat fin extending upwardly from a top side of the base portion;

a wick receiver disposed above the top side of the base portion;

the wick carried by the wick receiver with the wick disposed above the base portion;

a fluid path defined through the base portion, the fluid path extending between a supply area of liquefied fuel below the base portion and the top side of the base portion; and

a second fluid path extending from the wick and disposed above the base portion;

wherein the first fluid path is spaced from the second fluid path, and the first fluid path and the second fluid path provide fluid communication between the supply area and the wick.

19. The wick assembly of claim 18, wherein the base portion comprises a capillary skirt extending downwardly from an outer periphery of a top wall, the capillary skirt and the top wall at least partly defining the supply area of liquefied fuel, wherein the first fluid path comprises an opening through the top wall, and the second fluid path comprises a lateral opening defined by a portion of the wick receiver.

20. The wick assembly of claim 19 further comprising a second heat fin extending upwardly from the top side of the base portion and spaced from the first heat fin, the wick receiver comprising a barrel spaced above the top wall and carried by the first heat fin and the second heat fin, and the barrel comprising and indentation to retain the wick.

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