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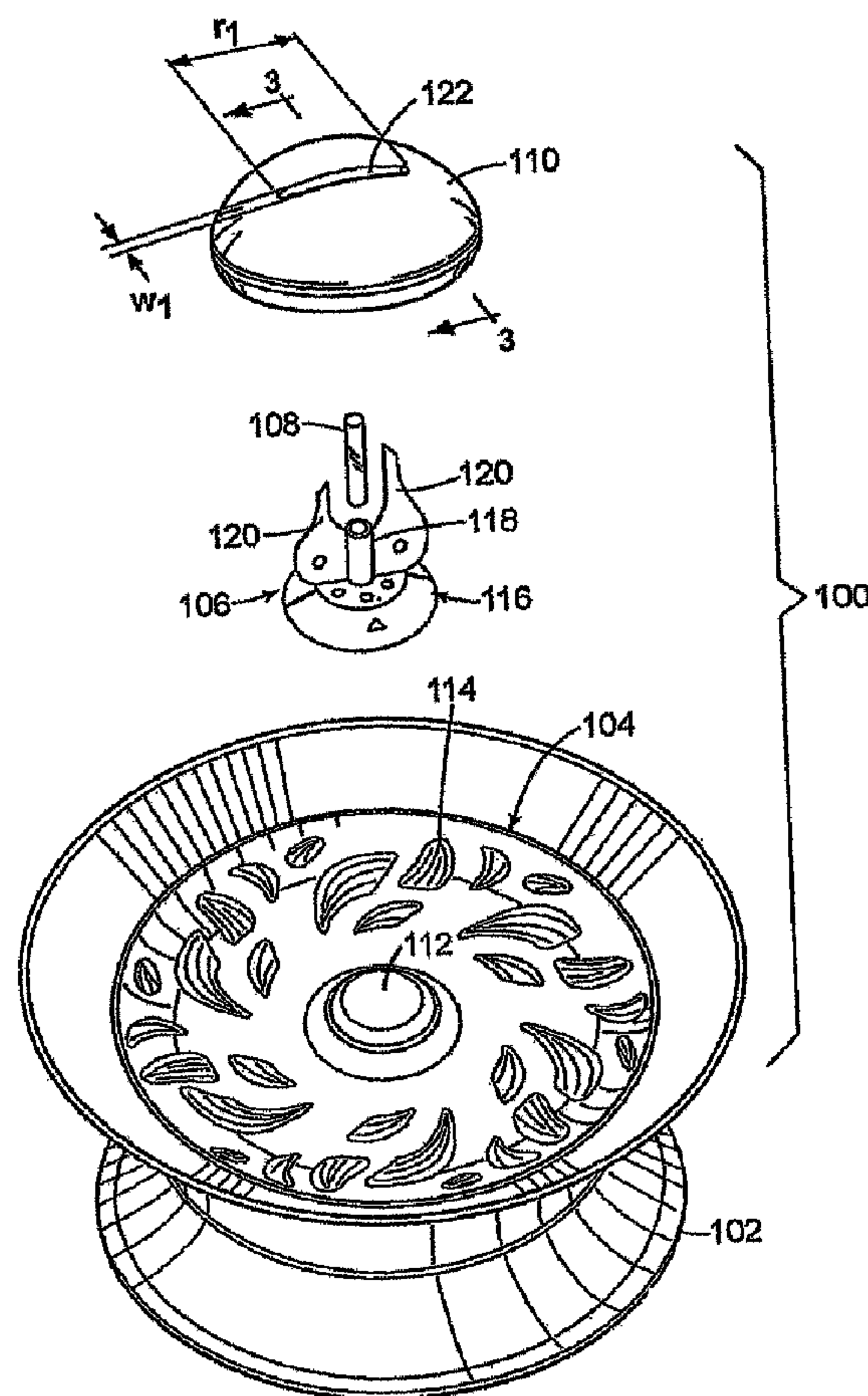
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(54) Title: WICK HOLDER



(57) **Abrégé/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

(57) **Abrégé(suite)/Abstract(continued):**

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.

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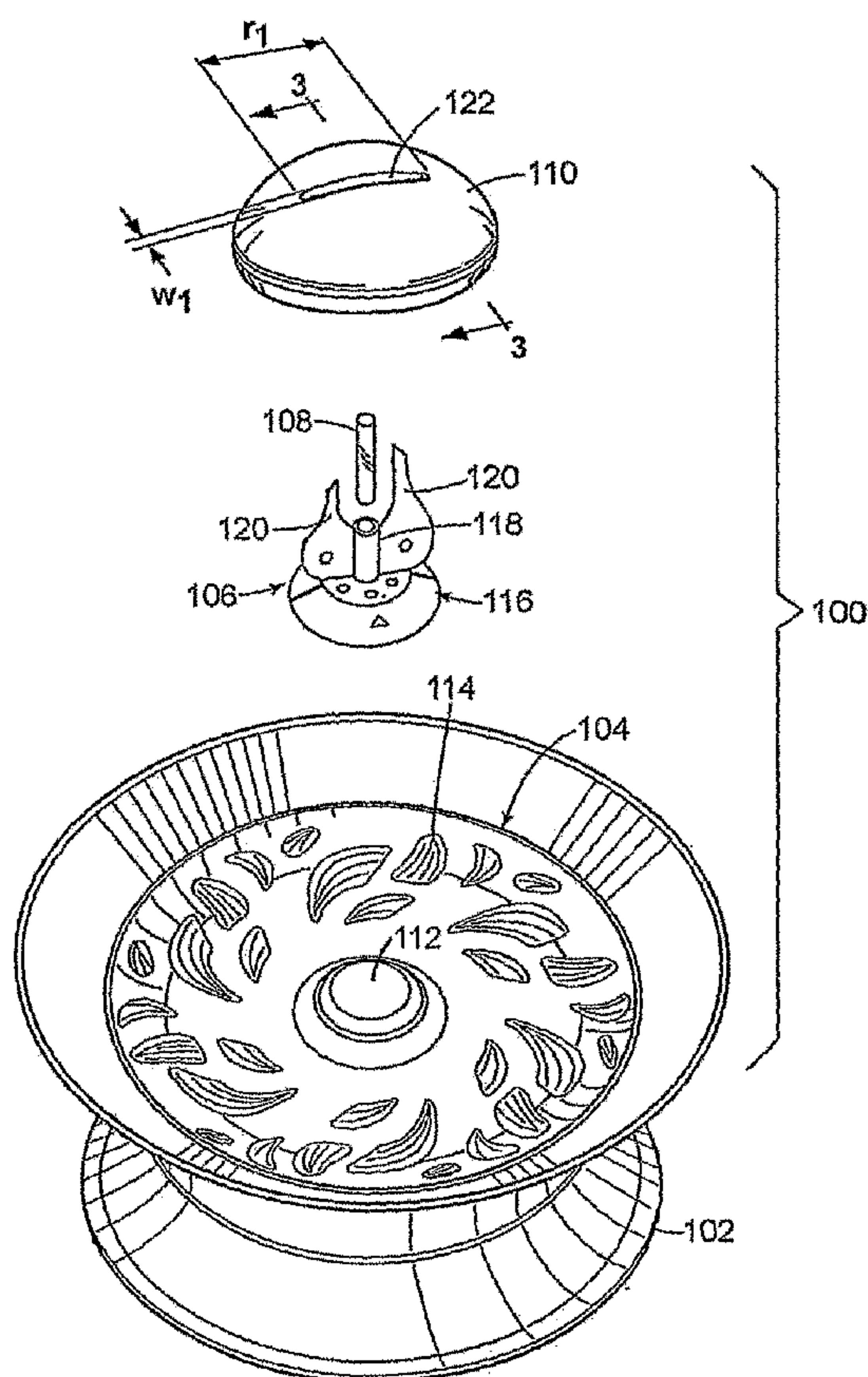
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(54) Title: WICK HOLDER



(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.

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TITLE
WICK HOLDER

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation-in-part of U.S. Patent Application 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 No. 10/978,744, filed November 1, 2004, which is a continuation-in-part of U.S. Patent Application No. 10/938,434, filed September 10, 2004. This application is also a continuation-in-part of U.S. Patent Application No. 10/938,453, filed September 10, 2004.

REFERENCE REGARDING FEDERALLY SPONSORED RESEARCH OR
DEVELOPMENT

[0002] Not applicable

SEQUENTIAL LISTING

[0003] Not applicable

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0004] The present invention relates to a wick holder for holding a wick in a candle assembly.

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2. Description of the Background of the Invention

[0005] It is known 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

[0006] 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.

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

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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.

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.

[0007] Other aspects and advantages of the present invention will become apparent upon consideration of the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 is an exploded isometric view of a candle assembly according to one aspect of the present invention;

[0009] FIG. 2 is an enlarged isometric view of a wick holder shown in FIG. 1;

[0010] FIG. 3 is a cross-sectional view of a fuel element along the line 3-3 of FIG. 1;

[0011] FIG. 4 is a cross-sectional view generally transverse to line 3-3 of FIG. 1 with the candle assembly in assembled form;

[0012] FIG. 5 is an enlarged partial cross-sectional view along the line 5-5 of FIG. 4;

[0013] 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;

[0014] FIG. 7 is an isometric view of still another wick holder according to the present invention;

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[0015] 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;

[0016] 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

[0017] FIG. 10 is an isometric view of a wick holder according to yet another aspect of the invention.

DETAILED DESCRIPTION

[0018] 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 3 ½ hours on a single fuel element, such as the wax fuel element 110, before the fuel is completely consumed.

[0019] 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

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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 No. 10/939,039, filed September 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

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areas 150. An example of such capillary action is described in U.S. Patent Application No. 10/938,453.

[0020] 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.

[0021] 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

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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.

[0022] 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.

[0023] 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

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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

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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.

[0024] 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.

[0025] 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

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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.

[0026] 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.

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[0027] 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,

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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.

[0028] 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, $\text{in}^3/\text{cal}/^\circ\text{C}$) ($1 \text{ mm}^3/\text{cal}/^\circ\text{C}$) and about $0.0006 \text{ in}^3/\text{cal}/^\circ\text{C}$ ($10 \text{ mm}^3/\text{cal}/^\circ\text{C}$), or between about $0.0001 \text{ in}^3/\text{cal}/^\circ\text{C}$ ($2 \text{ mm}^3/\text{cal}/^\circ\text{C}$) and about $0.0004 \text{ in}^3/\text{cal}/^\circ\text{C}$ ($6 \text{ mm}^3/\text{cal}/^\circ\text{C}$), or between about $0.00018 \text{ in}^3/\text{cal}/^\circ\text{C}$ ($3 \text{ mm}^3/\text{cal}/^\circ\text{C}$) and about $0.00024 \text{ in}^3/\text{cal}/^\circ\text{C}$ ($4 \text{ mm}^3/\text{cal}/^\circ\text{C}$). Accordingly, in one embodiment, the thermal mass of the candle assembly is between about $135 \text{ cal}/^\circ\text{C}$ and about $10 \text{ cal}/^\circ\text{C}$, or between about $75 \text{ cal}/^\circ\text{C}$ and about $40 \text{ cal}/^\circ\text{C}$, or between about $61 \text{ cal}/^\circ\text{C}$ and about $50 \text{ cal}/^\circ\text{C}$, 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).

[0029] 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

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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 in³ (200 mm³).

[0030] Figure 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

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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.

[0031] 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

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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.

[0032] 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

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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.

[0033] 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.

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INDUSTRIAL APPLICABILITY

[0034] 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.

[0035] 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.

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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.

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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.

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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.

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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 an indentation to retain the wick.

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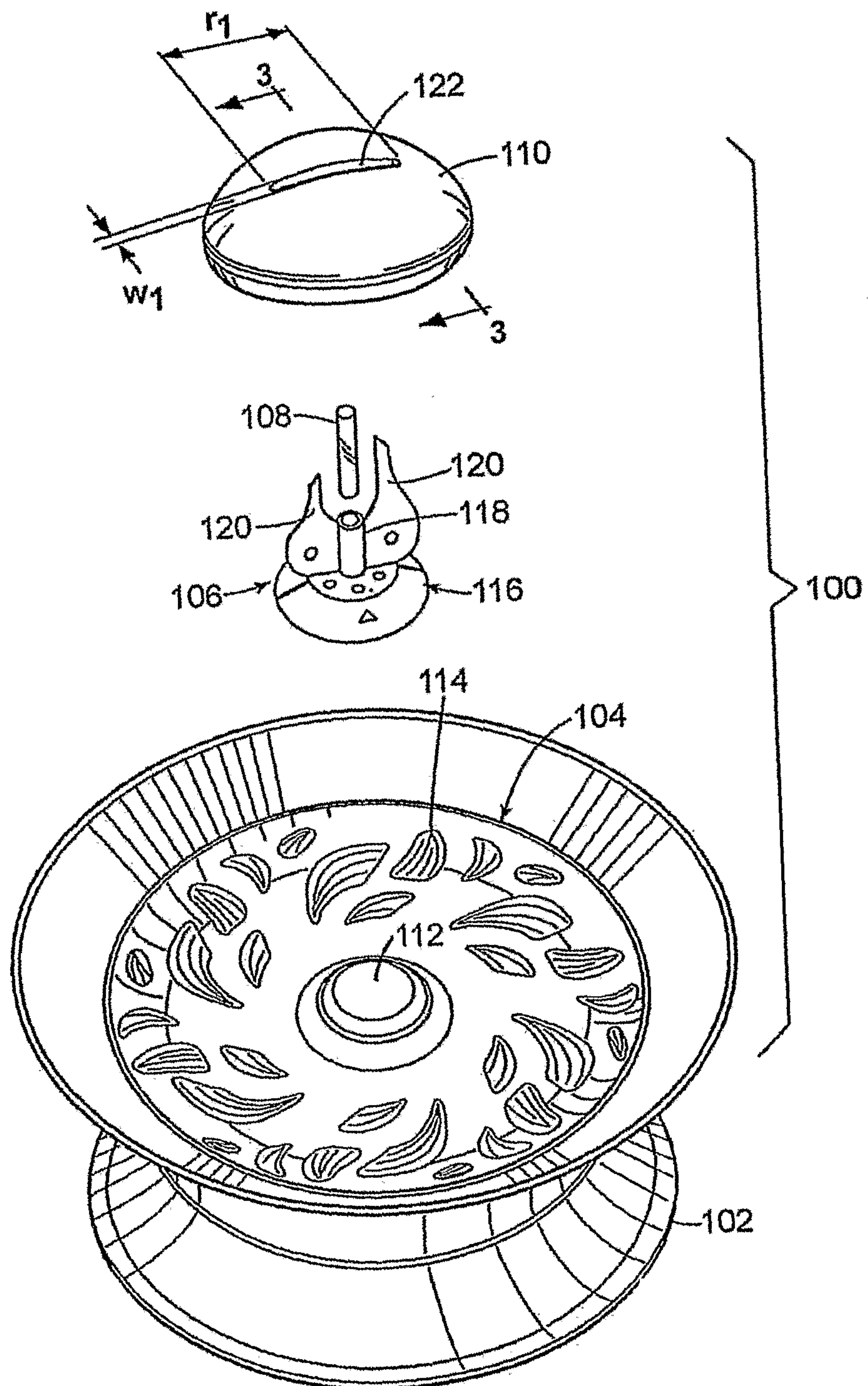


FIG. 1

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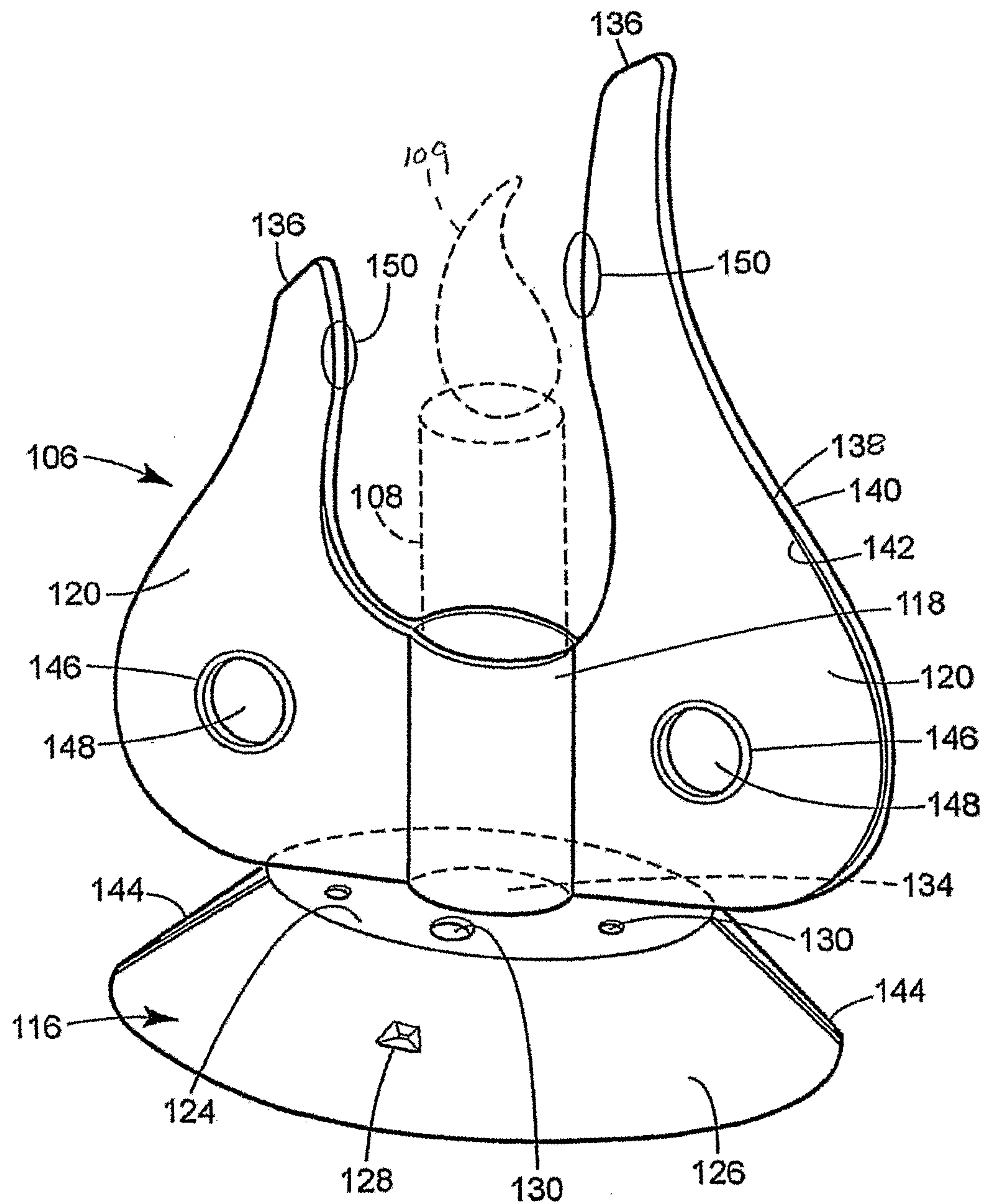


FIG. 2

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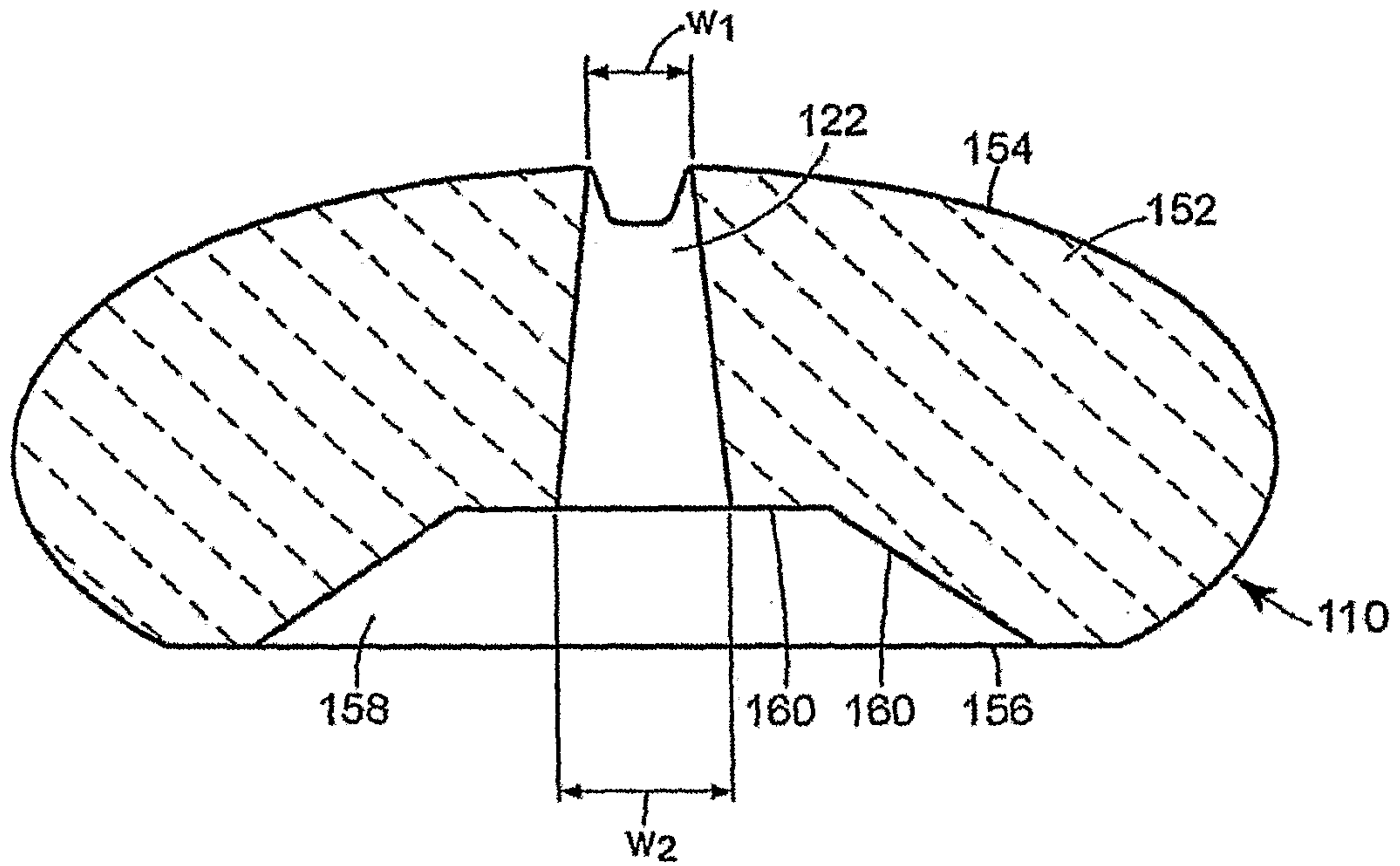


FIG. 3

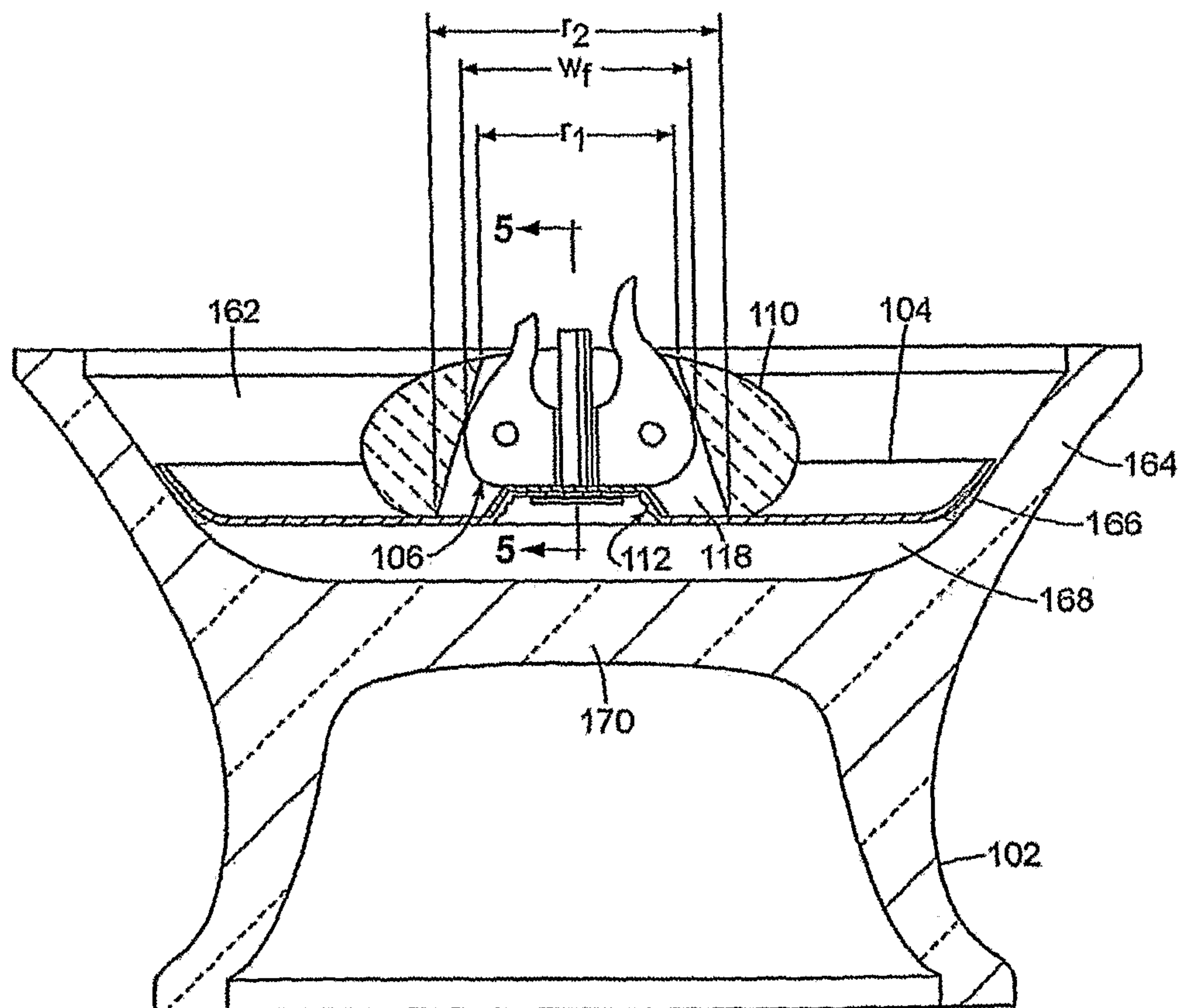


FIG. 4

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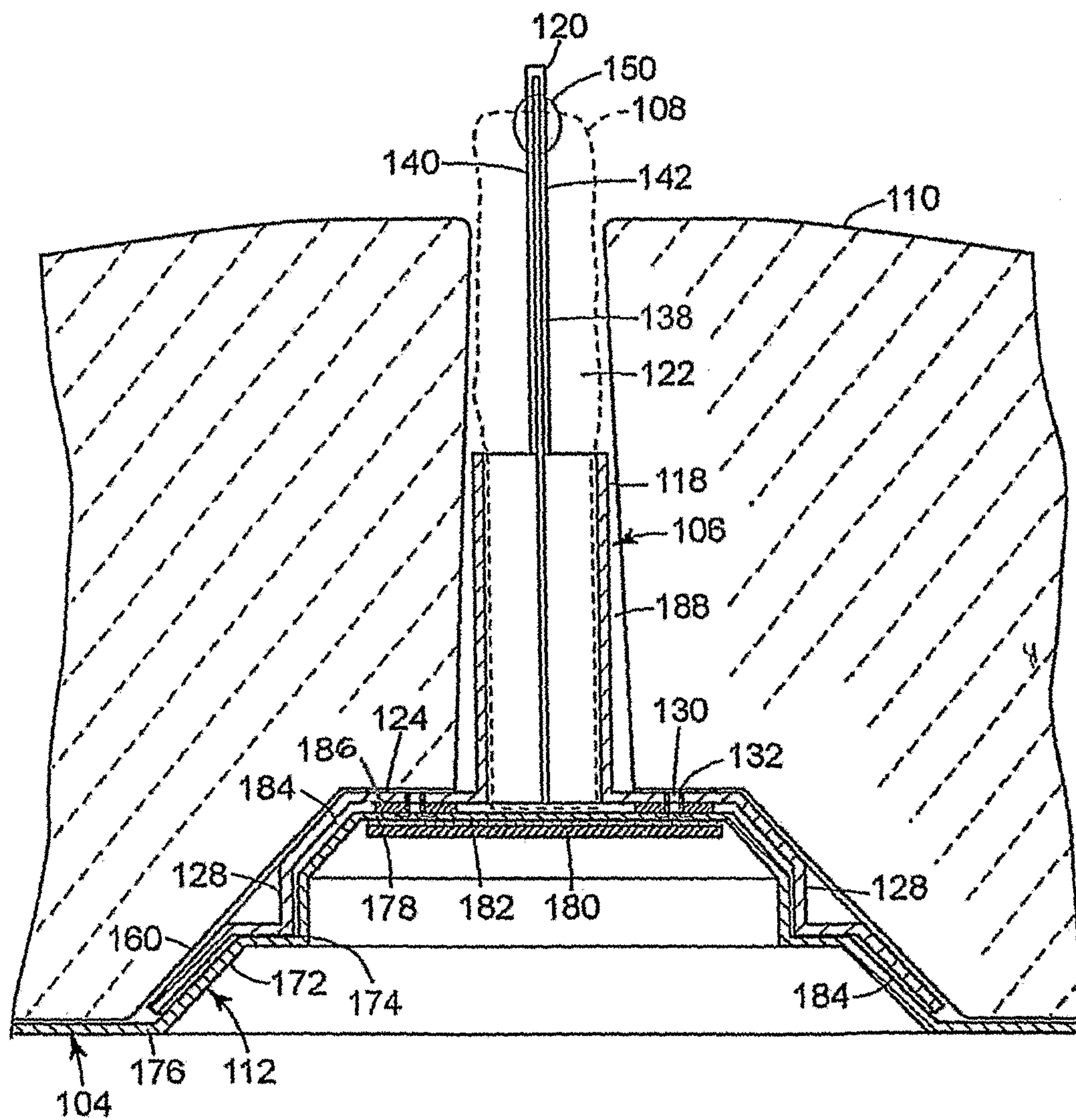


FIG. 5

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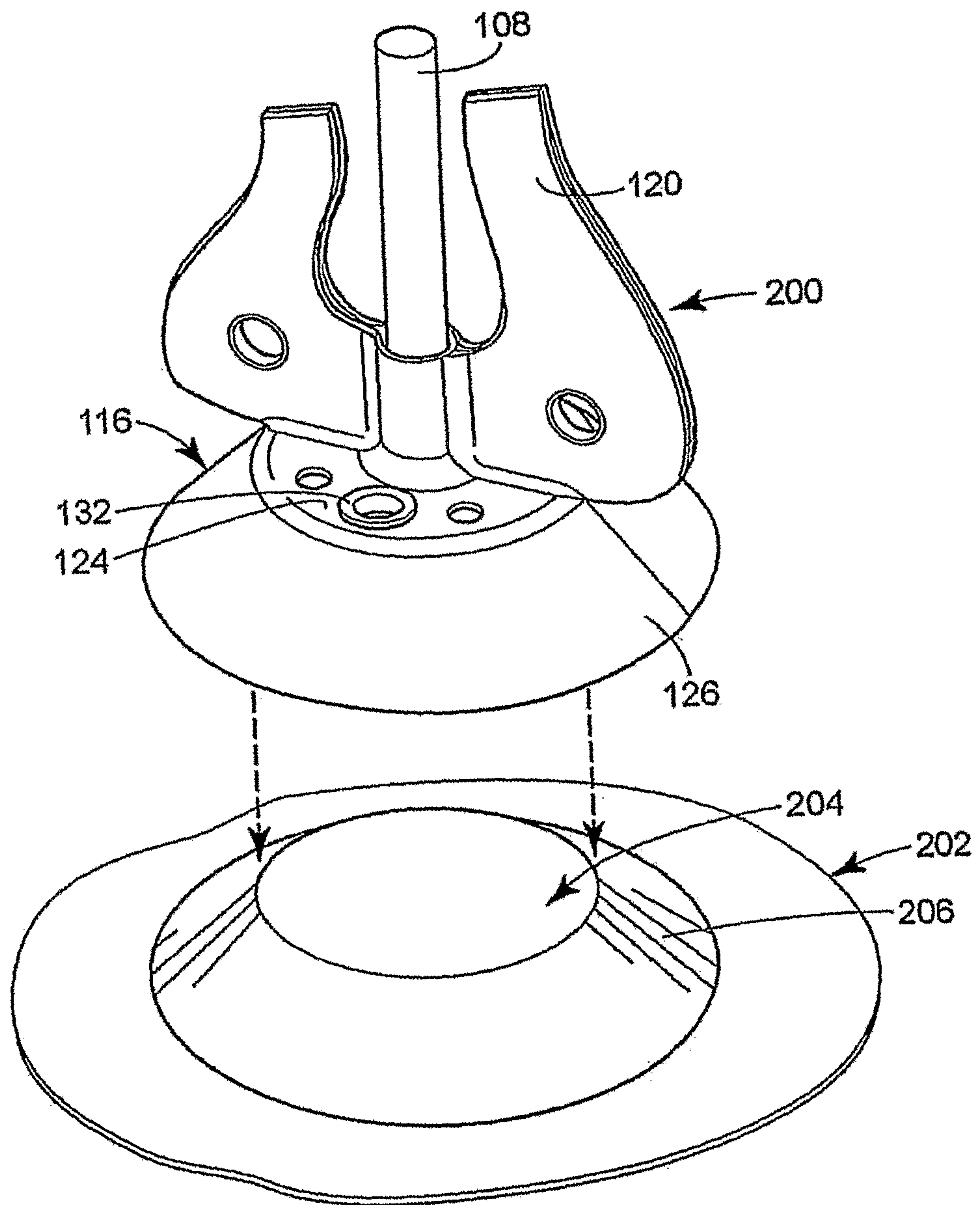


FIG. 6

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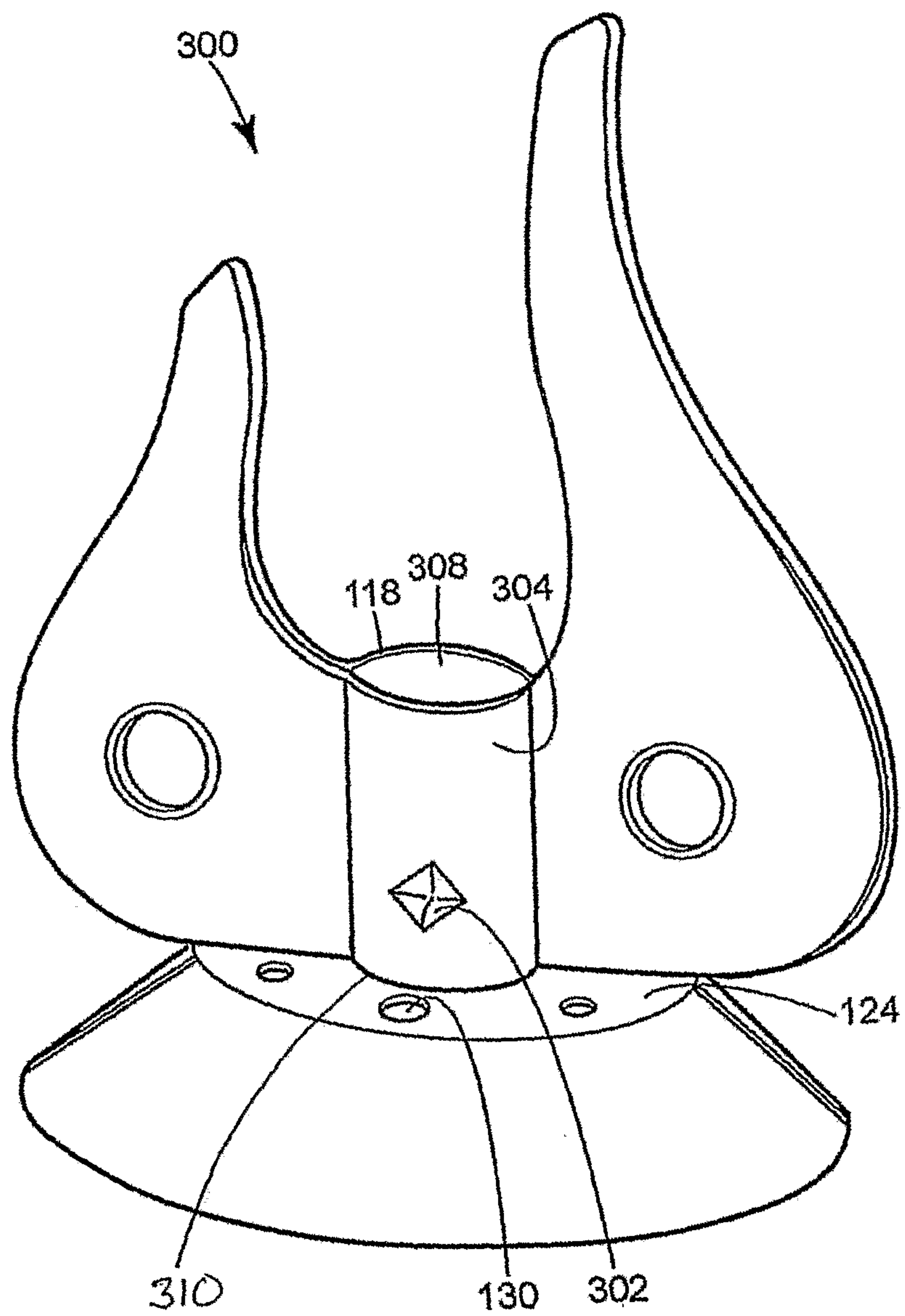


FIG. 7

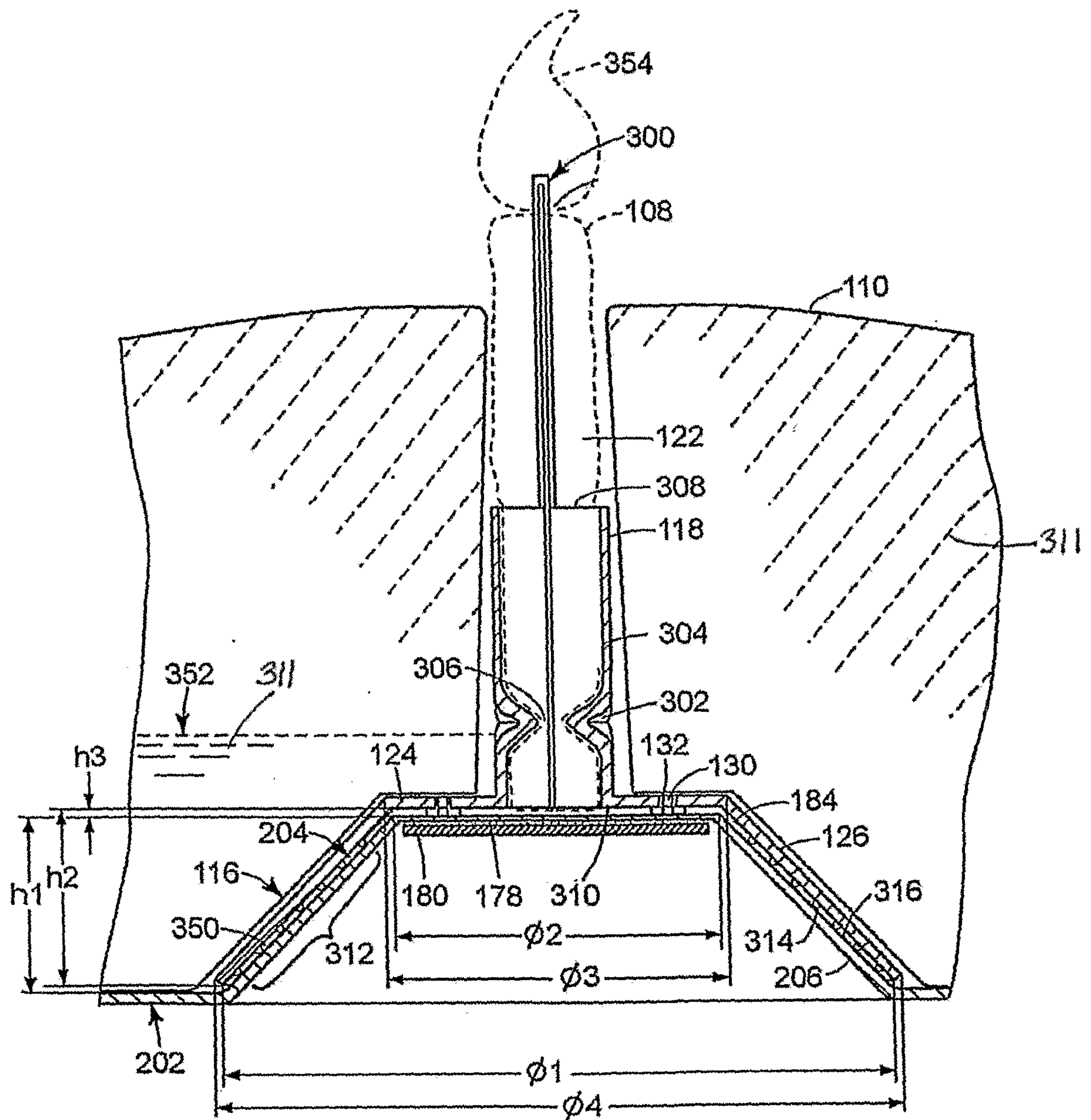


FIG. 8

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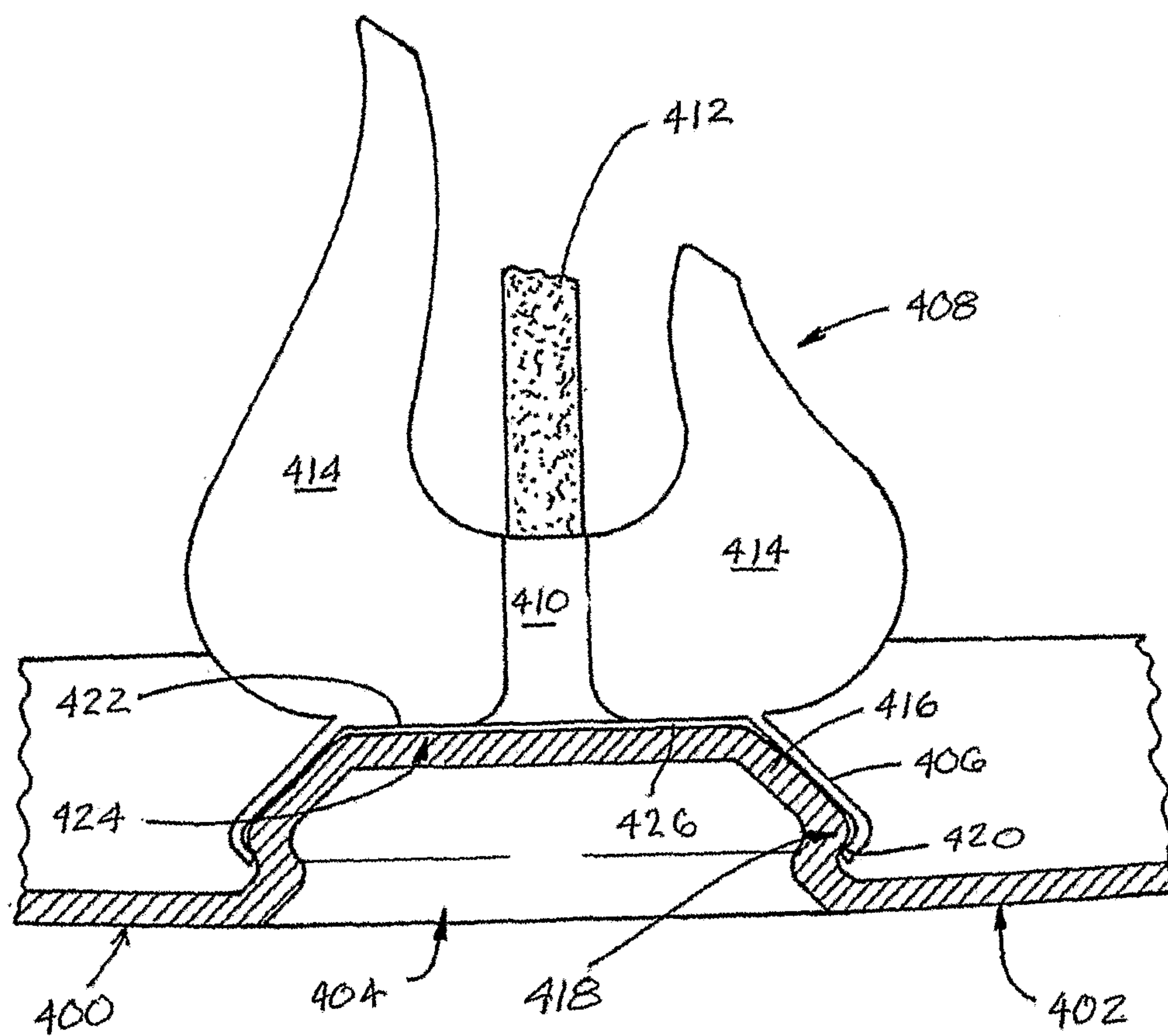


FIG. 9

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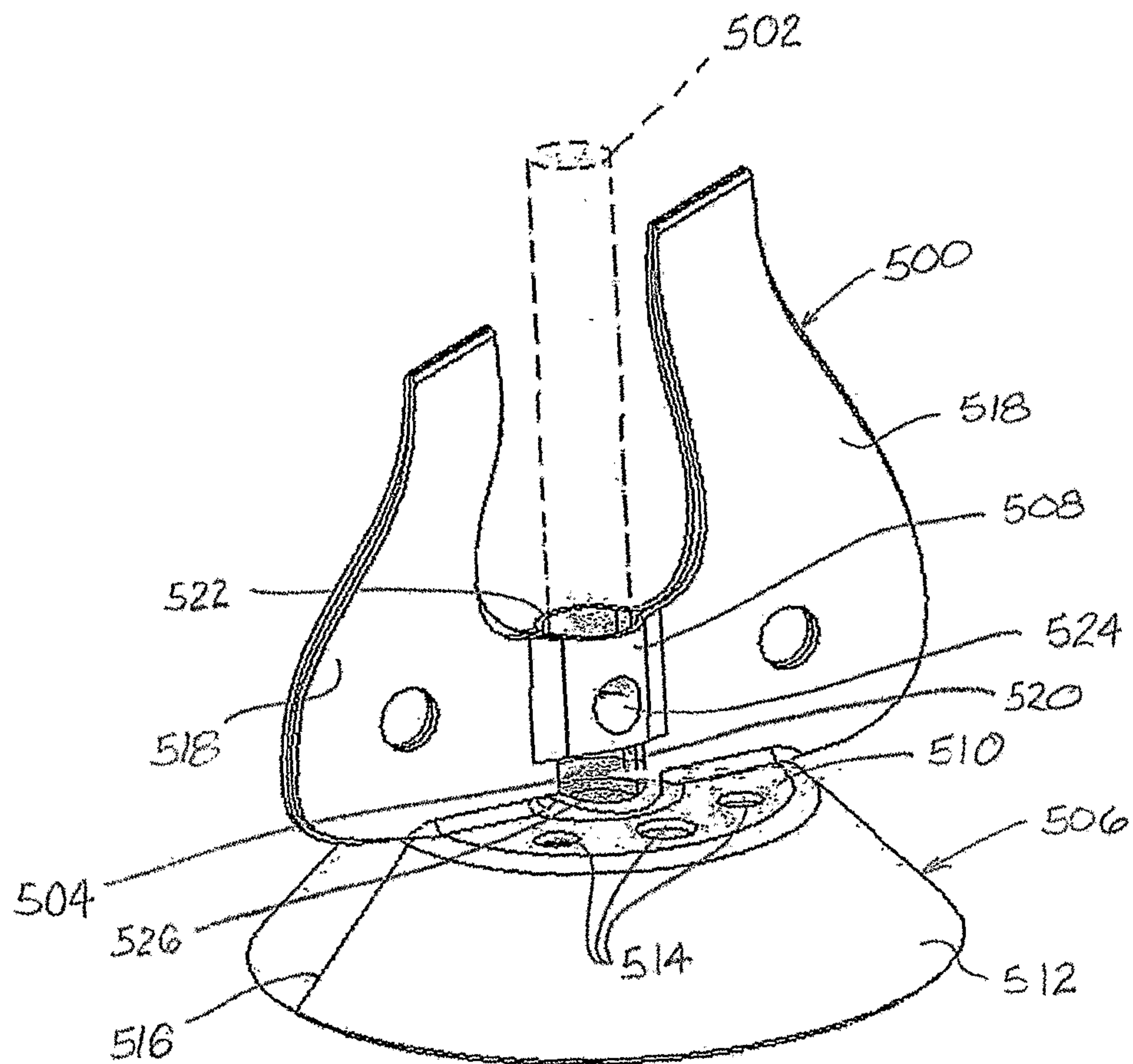
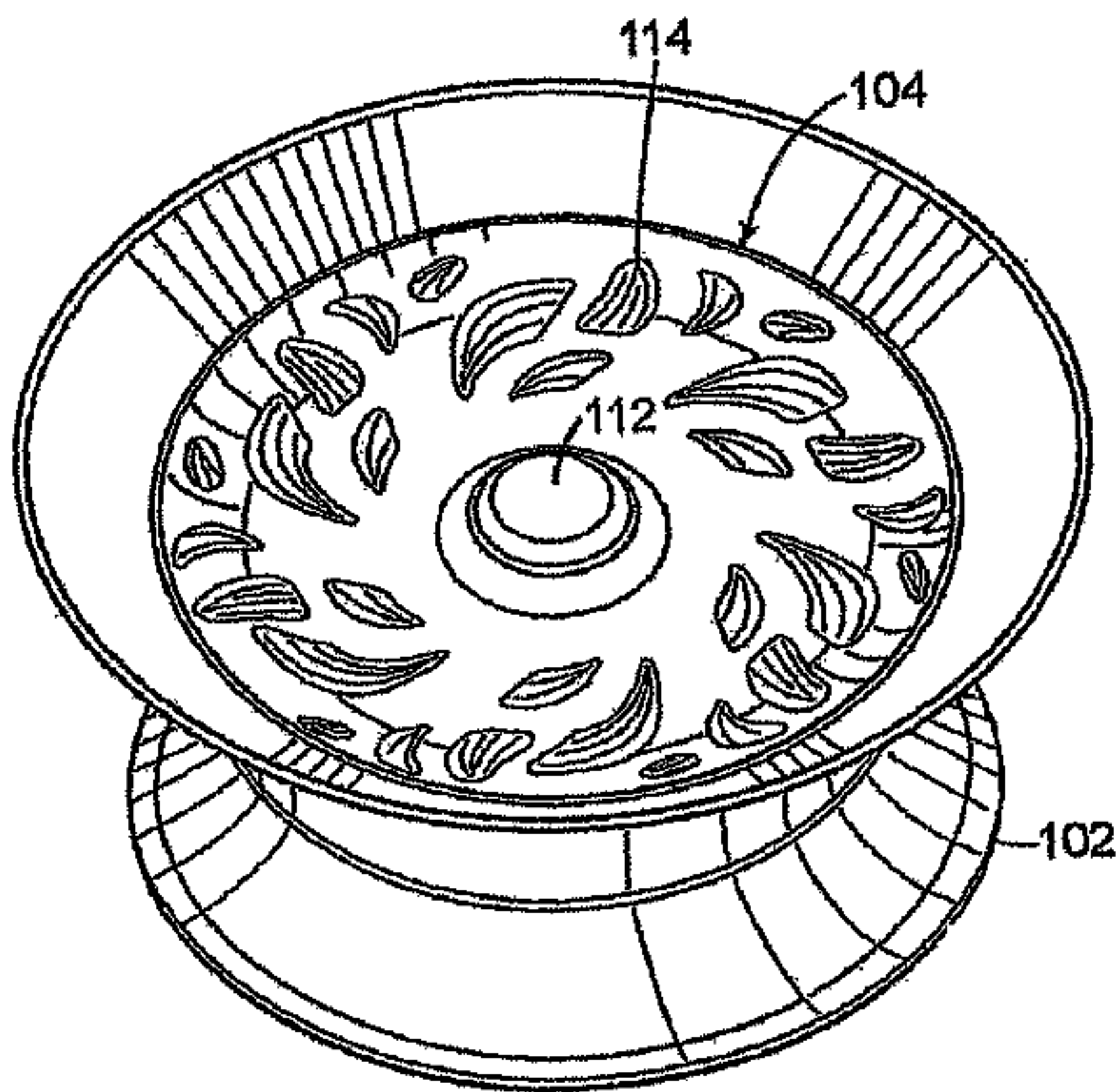
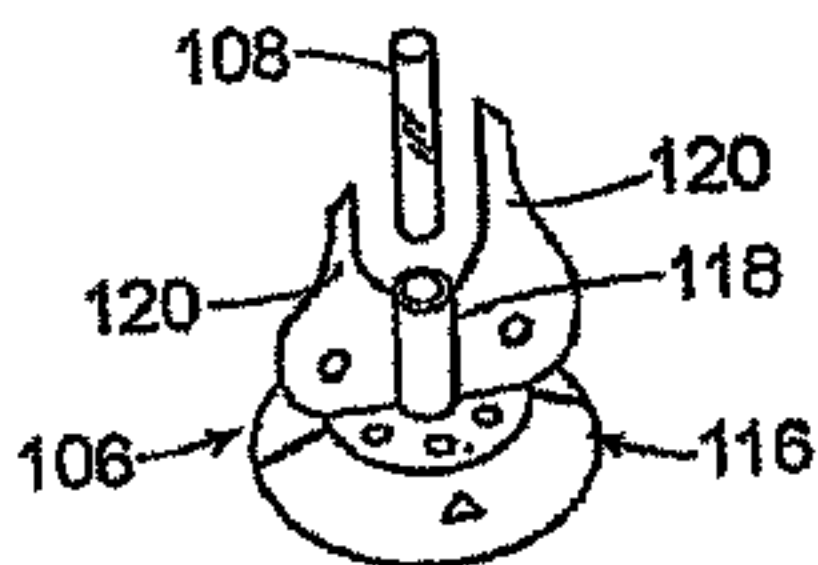
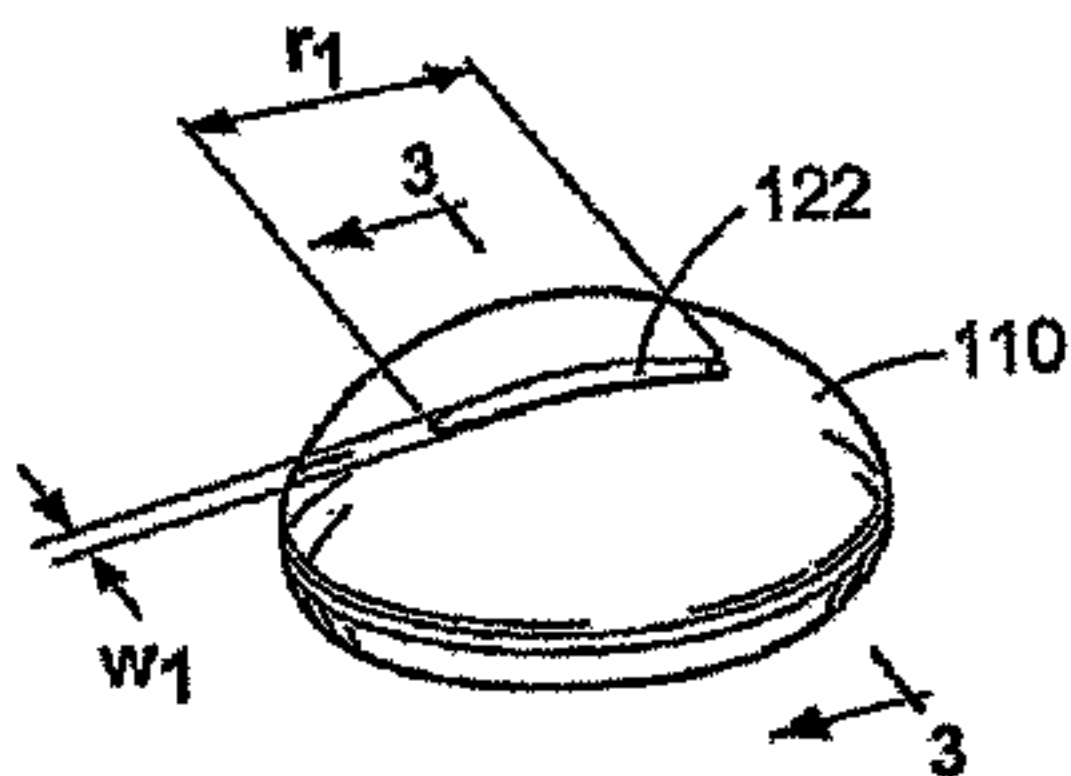


FIG. 10



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