Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2578860 C 2011/07/12

(11)(21) 2 578 860

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 2005/09/09
(87) Date publication PCT/PCT Publication Date: 2006/03/23
(45) Date de délivrance/Issue Date: 2011/07/12
(85) Entrée phase nationale/National Entry: 2007/02/27
(86) N° demande PCT/PCT Application No.: US 2005/032518
(87) N° publication PCT/PCT Publication No.: 2006/031790
(30) Priorités/Priorities: 2004/09/10 (US10/939,039);
2004/12/15 (US11/012,707)

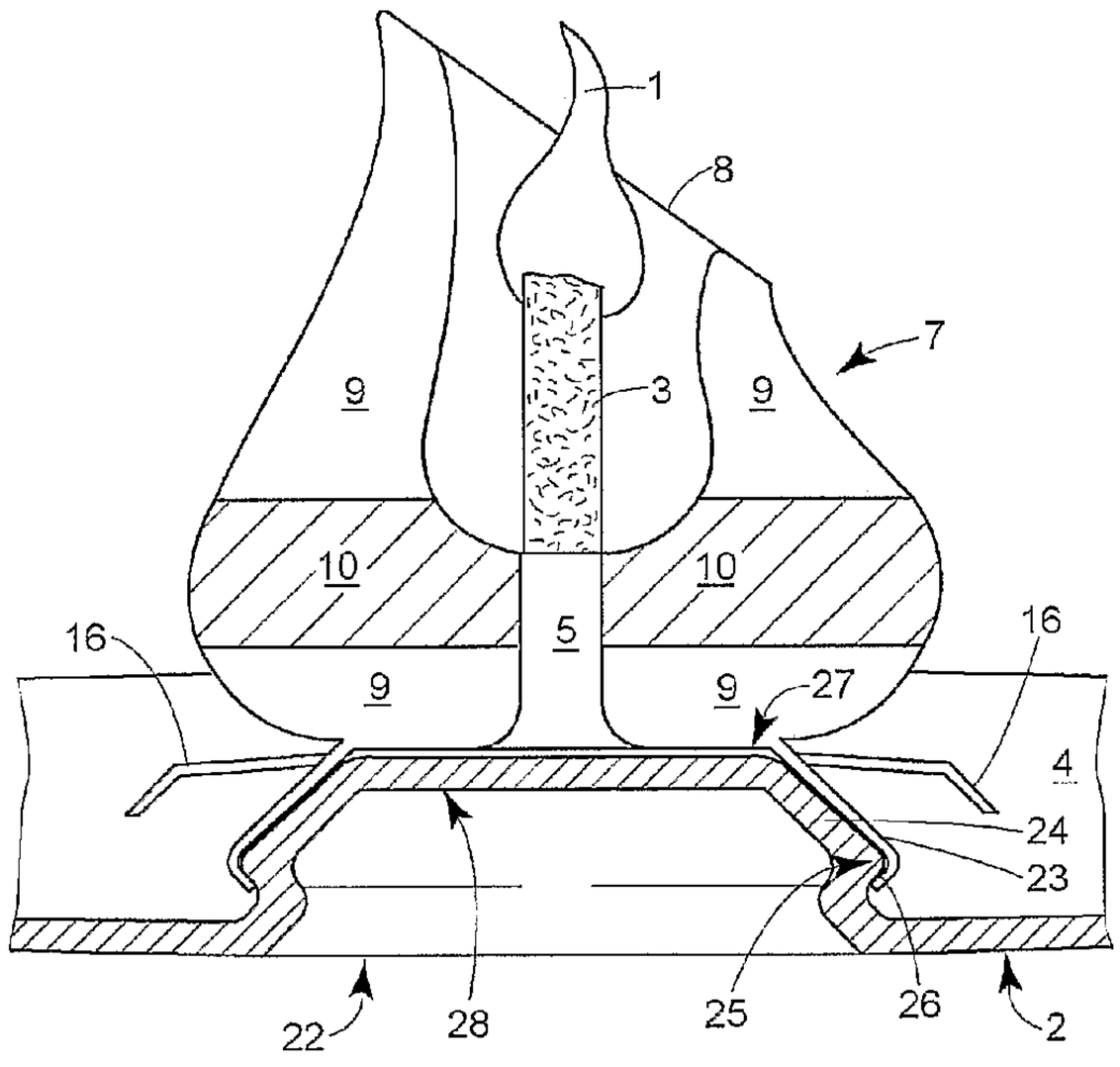
(51) Cl.Int./Int.Cl. *F21V 37/00* (2006.01),
A01M 1/20 (2006.01), *A61L 9/03* (2006.01),
F21L 19/00 (2006.01), *F23D 3/16* (2006.01),
F23D 3/24 (2006.01)

(72) Inventeurs/Inventors:
ADAIR, JOEL E., US;
DWYER, SEAN G., US;
JAMESON, ELIZABETH J., US;
KUBICEK, CHRIS A., US;
VARANASI, PADMA PRABODH, US;
TENHAGEN, GEORGIA A., US

(73) Propriétaire/Owner:
S. C. JOHNSON & SON, INC., US

(74) Agent: BERESKIN & PARR LLP/S.E.N.C.R.L.,S.R.L.

(54) Titre : ECHANGE DE CHALEUR AMELIORE POUR BOUGIE AVEC PLAQUE DE FONTE
(54) Title: IMPROVED HEAT EXCHANGE FOR MELTING PLATE CANDLE



(57) Abrégé/Abstract:
The present invention relates to melting plate candles which employ heat conductive elements to distribute heat from a burning flame at a wick to a support plate for a solid fuel and to the body of the solid fuel, so as to more rapidly liquefy the solid fuel, such as paraffin wax, and to more uniformly and intensely heat such fuels to increase the efficiency of consumption thereof and to more rapidly release volatile materials contained within the fuels. The heat conductive support plate is configured so as to have a capillary pedestal upon the surface thereof, which cooperatively engages a wick holder comprising a preferably consumable wick and heat conductive fins which conduct heat from a flame upon the wick to the support plate, the wick holder further engaging the capillary pedestal in such a locking manner as to resist accidental removal from the pedestal. The fuel may be provided in various forms, configured to cooperatively engage the wick holder and support plate, and may comprise various volatile materials. The capillary pedestal, in conjunction with the wick holder, causes rapid and complete flow of the liquefied fuel to the wick. The capillary pedestal and wick holder are shaped so as to provide for variance of capillary flow between them when the wick holder is rotated relative to the capillary pedestal.

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

(19) World Intellectual Property Organization
International Bureau

PCT

(43) International Publication Date
23 March 2006 (23.03.2006)

(10) International Publication Number
WO 2006/031790 A1

(51) International Patent Classification:
F21V 37/00 (2006.01) *A01M 1/20* (2006.01)
F21L 19/00 (2006.01) *F23D 3/16* (2006.01)
A61L 9/03 (2006.01) *F23D 3/24* (2006.01)

(21) International Application Number:
PCT/US2005/032518

(22) International Filing Date:
9 September 2005 (09.09.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10/939,039 10 September 2004 (10.09.2004) US
11/012,707 15 December 2004 (15.12.2004) US

(71) Applicant *(for all designated States except US)*: **S. C. JOHNSON & SON, INC.** [US/US]; 1525 Howe Street, Racine, WI 53403 (US).

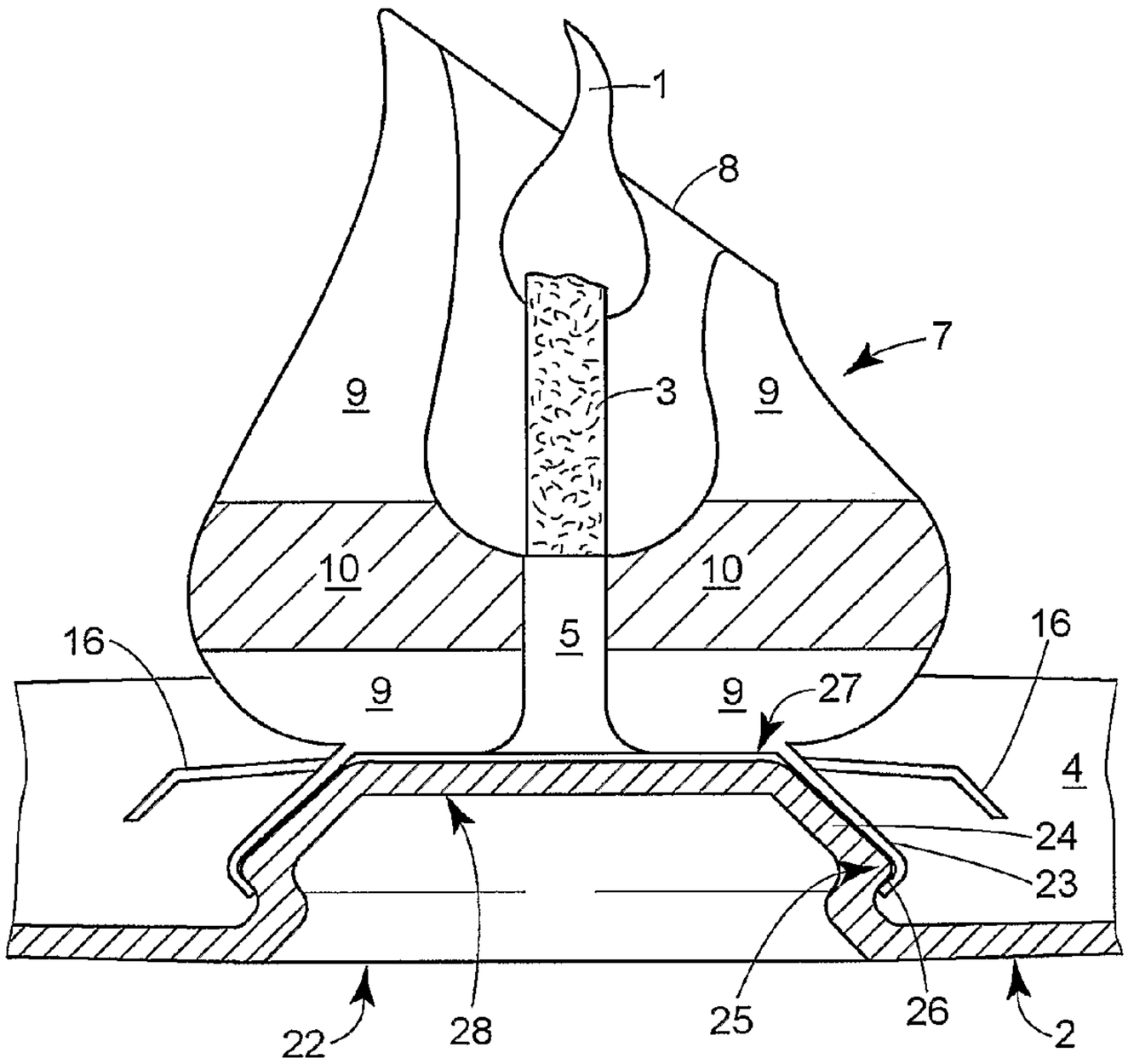
(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **ADAIR, Joel, E.** [US/US]; 3607 Candle Court #3, Racine, WI 53402 (US). **DWYER, Sean, G.** [US/US]; 12 Sandalwood Court, Racine, WI 53402 (US). **JAMESON, Elizabeth, J.** [US/US]; 3410 North Green Bay Road, Racine, Wisconsin 53404 (US). **KUBICEK, Chris, A.** [US/US]; w2044 Kings Parkway, East Troy, WI 53120 (US). **VARANASI, Padma, Prabodh** [US/US]; 2 Cherrywood Court, Racine, WI 53402 (US). **TENHAGEN, Georgia, A.** [US/US]; 226 Park Street, Elkhorn, WI 53121 (US).

(74) Agent: **CHAPMAN, Kristrin, L.**; S. C. Johnson & Son, Inc., 1525 Howe Street, Racine, WI 53403 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

[Continued on next page]

(54) Title: IMPROVED HEAT EXCHANGE FOR MELTING PLATE CANDLE



(57) Abstract: The present invention relates to melting plate candles which employ heat conductive elements to distribute heat from a burning flame at a wick to a support plate for a solid fuel and to the body of the solid fuel, so as to more rapidly liquefy the solid fuel, such as paraffin wax, and to more uniformly and intensely heat such fuels to increase the efficiency of consumption thereof and to more rapidly release volatile materials contained within the fuels. The heat conductive support plate is configured so as to have a capillary pedestal upon the surface thereof, which cooperatively engages a wick holder comprising a preferably consumable wick and heat conductive fins which conduct heat from a flame upon the wick to the support plate, the wick holder further engaging the capillary pedestal in such a locking manner as to resist accidental removal from the pedestal. The fuel may be provided in various forms, configured to cooperatively engage the wick holder and support plate, and may comprise various volatile materials. The capillary pedestal, in conjunction with the wick holder, causes rapid and complete flow of the liquefied fuel to the wick. The capillary pedestal and wick holder are shaped so as to provide for variance of capillary flow between them when the wick holder is rotated relative to the capillary pedestal.

WO 2006/031790 A1

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

IMPROVED HEAT EXCHANGE FOR MELTING PLATE CANDLE

BACKGROUND OF THE INVENTION

Field of the invention

[0001] The present invention relates generally to candles and more specifically to an improved heat exchange for melting plate candles.

Description of the Related Art

[0002] Clips which locate and secure wicks for candles and for devices which dispense vapors into the ambient air are well known in the art, and useful in many applications. In candles, such clips provide a means to position the wick for the most efficient provision of fuel, such as candle wax, to the flame, while in vapor dispensing devices, such wick clips secure a wick by which a vaporizable liquid is delivered from a reservoir to an exposed surface.

[0003] More recently, melting plate candles and simmer plate dispensers have been used to provide rapid melting of a solid fuel element and/or rapid dispensing of a vaporizable material to the atmosphere. An example of such a dispensing device is shown in U.S. Patent 6,780,382, issued August 24, 2004, in which a dispenser for active materials is shown. This reference, incorporated herein by reference, illustrates a melting plate dispenser of volatile materials comprising a solid fuel containing active material, a consumable wick, and a heat conductive base having conductive elements, and the configuration of such elements.

[0004] In U.S. Patent 6,802,707, issued October 12, 2004, a melting plate candle comprising solid fuel, a consumable wick, a concave melting plate comprising a lobe by which heat is conducted from the flame upon the candle to the plate, and the configuration of such elements, are shown.

[0005] In addition to the above, Application Serial Number 10/780,028, filed February 17, 2004, teaches a candle comprising solid fuel, a melting plate, a lobe that engages

a wick holder which comprises a wick and which conducts heat to said lobe and to said melting plate. In this application, said wick holder engages said lobe in such a manner as to create a capillary flow of melted fuel to the wick itself.

[0006] In each of the above references, the melting plate candle provides a relatively rapid means for heating the solid fuel to its melting point, thereby improving efficiency of the candle. However, it has now been found that even more efficient, and more particularly, more rapid melting of the solid fuel may be achieved by means of specific modifications of the wick holding device.

SUMMARY OF THE INVENTION

[0007] In one aspect of the invention, a replaceable fuel element for a melting plate candle includes a solid fuel material cooperatively engaging a wick holder comprising a wick. The wick holder is configured to lockingly engage a capillary pedestal on the melting plate candle. The wick holder includes heat fins which pass through a flame upon the wick and conduct heat from the flame to the fuel element by means of one or more branches which extend outward from the fins into the fuel element. The fins are optionally insulated so as to inhibit heat loss between the flame and the fuel element.

[0008] Also disclosed herein is a melting plate candle including a meltable solid fuel, a support plate upon which the meltable solid fuel rests and a wick holder. The wick holder has a wick and a heat conductive fin positioned in close proximity to a flame upon the wick to conduct heat from the flame to the meltable solid fuel and to the support plate, the wick holder engaging the meltable solid fuel. The heat conductive fin optionally has an insulated area to inhibit heat loss from the fin.

[0009] These and other embodiments of the invention shall be illustrated in the figures and description which follow.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. 1 illustrates the basic concept of a melting plate candle of the prior art, in simplified perspective view, of which the present invention constitutes an improvement;

[0011] FIG. 2 illustrates a basic melting plate candle, in simplified cross section, absent the locking wick holder and improvements of the present invention;

[0012] FIG. 3 is a simplified cross section of a melting plate candle, showing the capillary pedestal, the locking wick holder with fins in accordance with the present invention, and the relationship between the elements;

[0013] FIG. 4 is an exploded view of a melting plate having a capillary pedestal, with a wick holder as described herein with fins and incorporated wick, and a fuel element;

[0014] FIG. 5 is a perspective view of the assembled melting plate, wick holder, and fuel element of FIG. 4; and

[0015] FIG. 6 is a perspective view of the rotating lever means for adjusting the capillary gap area of the wick clip upon the capillary lobe.

DETAILED DESCRIPTION OF THE INVENTION

[0016] Ordinary candles comprise a vertical, self-supporting body or column of wax, with a substantially horizontal top and a central longitudinal wick which extends through and above the wax. The exposed portion of the wick above the solid wax is lighted by a flame, and the heat generated by the flame melts a small volume of the wax at the top of the candle, adjacent the wick, establishing a puddle or reservoir of molten wax to serve as fuel for the flame on the wick, and to release any volatile actives present therein. The capillary attraction of the molten wax and the wick, which is generally a structure of closely related fibers, causes the molten wax to travel through the wick to the flame, by which it is consumed. As the wax is consumed in this manner, the body of wax diminishes and the top surface thereof progressively lowers. The upper portion of the wick, extending above the lowering wax, is generally consumed by the flame. The flame in such a candle remains in the same position relative to the horizontal center of the candle, but decreases in height relative to the surface upon which

the candle rests, from the start to the end of the burn, at which time all or at least most of the wax has been consumed.

[0017] Also well known are such candles as votive candles and tea lights. For purpose of discussion, tea lights shall be considered to be relatively small candles in which a body of paraffin is located in a container, having a wick centrally disposed, while votive candles shall be considered to be candles of similar size provided without a container. At the lower end of the wick is typically found a wick clip having a flat horizontal bottom surface, which functions to retain the wick in its perpendicular position, even as the paraffin is melted and liquefied by the heat of the flame. In most such votive candles and tea lights, the wick is a cotton material saturated with paraffin, and burns with the paraffin, thus being consumable. In such candles, or lights or warmers employing the same, the visible flame moves lower, or closer to the bottom surface of the container as the fuel and wick are consumed, down to the level of the bottom of the wick. Further, after consumption of all of the wax above this point in the unit, the container (of the tea light), the unburned wax, and the wick clip remain to be disposed of by the consumer. As a safety consideration in such candles, the wick is normally crimped or terminated at a point about 0.25 inches above the bottom of the wax, so as to cause the flame to extinguish above the bottom of the container, and to thus prevent the heat of the flame from reaching the surface upon which the candle is positioned, preventing damage to such surface, and reducing the likelihood of igniting possible contaminants such as burnt matchsticks remaining at the bottom of the candle, or carbonaceous remains of the consumable wick. Such an arrangement also has the detriment of leaving a small volume of unburned wax in the bottom of the container when the flame extinguishes.

[0018] As utilized herein, the term melting plate candle shall encompass the combination of a solid fuel element and a heat conductive container or holder for the fuel. The terms fuel container and fuel holder shall be meant to encompass a support plate or melting plate comprising means to contain and melt the fuel element, and a wick holder engaging a wick and said support plate, the wick holder comprising heat conductive elements, such as fins, referred to hereinafter as either wick fins or heat fins. The wick holder shall also encompass a base having means such as magnetic means and/or a skirt or legs configured to engage a complimentarily shaped pedestal portion of the support plate, and to transfer heat from a

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

[0019] An element of the present invention constitutes a capillary pedestal on the melting plate, which pedestal provides a locating device for a complementarily shaped wick holder, creates a site for capillary feed of fuel to the wick, and provides a means for heat transfer from the flame to both the melting plate and the solid fuel. The wick holder, in addition to providing a mounting means for the wick, has a base which closely conforms to the capillary pedestal in such a manner as to create a capillary feed by which melted wax flows to the wick as fuel. Moreover, the capillary pedestal of the present invention is configured so as to engage the wick holder in such a manner that it may not be easily or accidentally removed from the pedestal. This may be accomplished magnetically, for

example, and/or by means of an undercut in the side of the pedestal, which undercut engages a complimentarily shaped leg or skirt of the wick holder, which leg or skirt may be made of a resilient material, such as a heat conductive metal, which is biased inwardly on the pedestal in the area of the undercut therein, so as to resist removal. This capillary pedestal and locking mechanism is set forth and claimed in US Patent Application 10/938,434, filed September 10, 2004, in the names of Kubicek *et al.*

[0020] In addition to the base and/or skirt of the wick holder being a heat conductive element, the wick holder preferably also provides an additional heat conductive element such as a fin or fins, which are in close proximity to, or in contact with the flame, and thereby conduct the maximum possible heat back to the wick holder base, and thus to the capillary pedestal, and thereby to both the melting plate and the fuel. It is to be understood that this arrangement of elements provides for much greater control of the degree of heating of the pool of melted wax, and the pool temperature, by virtue of the ability to control the amount of heat conducted to the pool by either the skirt of the wick holder or by the fins thereof. This may be accomplished by selection of the number of fins, for example, or control of the conductivity thereof, such as by choice of position relative to the flame, or material of construction. This in turn is most important in candles which dispense a volatile material, such as a fragrance, where a rapid temperature rise to the most effective temperature for volatilization of the active material is desired. Such a rapid temperature rise clearly results in a more rapid consumption of the fuel element, and a more rapid dispensing of volatile material. In fact, with the present invention, it is possible to tailor a melting plate candle to a specific volatile active to be contained within a fuel element, by permitting control of the amount of heat conducted to the pool of melted fuel, and thus controlling the temperature thereof.

[0021] The material of which the melting plate and the heat fins are fashioned should be of high thermal diffusivity, i.e., having high thermal conductivity, low density, and low specific heat. It has been found that the material of the wick clip should have a thermal capacity above about 0.10 cal/°C but below about 0.30 cal/°C. Such low thermal capacities decrease the melt time associated with melting the solid fuel element, and higher values tend to starve a newly initiated flame of heat, causing it to extinguish. The preferred materials

may be such metals as aluminum and copper. By use of such metals, one obtains the least resistance to heat transfer from the flame to the puck. Moreover, the region of the fins between the flame and the wax or the base of the wick holder should be insulated, so as to prevent loss of heat to the surrounding atmosphere, by either radiation or convectional means. The insulating material may be any conventional non-combustible material which may be readily applied to the surface of the heat fins, by any conventional method. In addition, it is beneficial to extend one or more portions of the wick holder base outward into the wax puck, so as to preferably transfer heat directly to the fuel element, rather than to the melting plate base. This also has the benefit of minimizing the supply of liquified fuel to the wick near the exhaustion of the fuel supply, thereby reducing the likelihood of flaring or re-ignition of the candle at the end of its life. Still another factor of the effectiveness of the transfer of heat from the heat fin to the solid fuel is the size of the heat fin, specifically with respect to surface area. The cross sectional area of the fins should be large enough to efficiently convey the collected heat. During the melting of the fuel element, it is desired that the heat transfer between the fin and the fuel be maximized, so relatively large horizontal surfaces are desirable. After the fuel has melted and formed a pool of liquid, it is desirable to minimize the heat transfer from the fins to the pool. The relationship between the horizontal wick clip area and the fuel element, or votive, may be represented by the so called "Quasivoto factor", defined as the fin surface area divided by the vertical cross section of the votive. For most efficient utilization, the "Quasivoto factor' should be greater than about 0.25 but less than about 0.75 before the fuel element is melted, and between about 0.125 and about 0.25 after the fuel element has fully melted. Advantage may be taken of the variable height of the molten pool of fuel by shaping the heat fins so as to be wide in the pre-melt pool, but narrower in the post melt pool. Still further, it has been calculated that the total cross sectional area of the fins at a point corresponding to the height of the wick should be less than approximately 1/4 the cross sectional area of the fins at a height corresponding to the surface of the solid fuel element, for a wick clip having a thermal diffusivity between about 1×10^{-5} and about 15×10^{-5} m^2 per second.

[0022] Alternative aspects of the present invention provide for the fuel element to be provided as a separate element which is complementarily shaped relative to the wick holder,

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

[0023] In addition, it has been found beneficial to insulate the area of contact between the wick holder and the capillary lobe of the melting plate candle holder so as to cause the greatest amount of heat flow from the flame to the wick fins to the wax puck itself, so as to most rapidly melt the wax puck. Thus, it is to be noted that while the present invention is described in terms of a melting plate candle comprising a capillary lobe and complimentarily shaped wick clip base, it is possible to apply the invention to wick clips to be employed in candles comprising a non-conductive base, whereby the heat is transferred directly to the wax puck by means of the heat fins, rather than to both the wax puck and a heat conductive melting plate base.

[0024] In accordance with an embodiment, it has been found beneficial to provide for variance of the gap between the wick holder and the capillary lobe of the melting plate candle holder so as to allow adjustability thereof. This is most easily accomplished by providing a capillary lobe which is not fully symmetrical, i.e., is not totally complimentary to the shape of the wick holder, so that as the wick holder is rotated upon the capillary lobe, areas of greater or less capillary activity between the two exist. In this manner, it is possible to vary the amount of capillary action occurring during the burning of the candle, and thus to vary the flow of melted fuel to the wick itself.

[0025] In either case, it is proposed that the highly heat conductive heat fins are so positioned as to capture the maximum heat output of the candle flame, by being located in the blue region of the flame, that the heat fins be insulated in the area between the flame and the solid fuel element, with which the heat fins are in direct contact, and that maximum release of the heat from the wick fins to the solid fuel element be achieved. This may preferably be

achieved by forming leaves or branches which extend from the fins, or from the wick holder base to which the heat fins attach, into the solid fuel element itself. Of course, the heat fins may also be so shaped as to maximize surface contact thereof with the solid fuel.

[0026] Accordingly, it is evident that the melting plate is preferably comprised of a heat conductive material, such as a metal, although less conductive materials, such as glass or ceramic may be employed. The preferred material for use as the melting plate is polished aluminum, due to its high efficiency as a conductor of heat, its light weight, and for aesthetic reasons. It is also possible that the melting plate may constitute a non-conductive body having a conductive surface applied thereto, such as a less conductive surface having a thin layer of metal applied thereto. In this regard, it is noted that the surface of the melting plate may also have a coating of a surface tension modifying material applied thereto for purposes of preparing a self cleaning or easy cleaning melting plate. For example, a thin layer of a polytetrafluoroethylene material may be applied over a rough surface to provide a smooth wetting surface upon which molten wax will flow easily, and which will enable easy removal of solidified wax upon extinguishing the flame and allowing the candle to cool.

[0027] The melting plate, which may act both as a fuel container and a heat transfer means to heat the fuel, is shaped so as to collect the melted or liquefied fuel at its lowest point, at which point a wick is preferably located by means of a wick holder positioned upon a capillary pedestal, so as to ensure that all fuel is fed to the wick, whereby the maximum consumption of the fuel is achieved. Thus, the melting plate is preferably shaped as a bowl, or in the form of a funnel, with the lowest portion thereof preferably, but not necessarily, centered. The entire interior surface of the fuel container is preferably highly heat conductive, and supports, contains, and heats the fuel, although containers in which only a small portion of the interior surface acts as a melting plate are within the scope of the present invention. Candles employing such melting plates shall be referred to, collectively, as melting plate candles. The melting plate itself may, of course, be essentially flat, with raised edges or a surrounding wall to contain the melted fuel.

[0028] Moreover, the melting plate helps to control the shape and depth of the pool of fuel which is burned at the wick, and to maintain the constancy thereof. It is to be understood that the fuel utilized in the present invention may be initially in solid or gel form, but must be

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

[0029] Generally, the melting plate device embodies both a melting plate and secondary heat conductive elements, which secondary elements are to be provided as part of the wick holder and pass through, or are in close proximity to the flame, to ensure more uniform and rapid distribution of heat from the flame upon the wick. The wick is affixed in its preferred position by means of the wick holder. The wick, which is preferably a consumable wick, may be any filamentary body which is sufficiently sturdy, which will burn with a

steady flame, and which is capable of drawing up the molten candle fuel by capillary action. Such a wick may be of any conventional consumable wick material, such as cotton, cellulose, nylon, or paper, but may be non-consumable as well. The wick holder and wick may preferably be located in the center of the candle, or may be off-center as desired. The presence of two or more wicks, and associated wick holders and capillary pedestals, is also within the scope of the present invention. In the present invention, the wick is preferably positioned in a wick holder which engages the melting plate by means of an appropriately located and shaped capillary pedestal on the melting plate, which serves to locate the wick holder (and thus, the wick), to transmit heat from the flame on the wick to both the fuel and the melting plate, and by means of the capillary nature of the appropriately sized gap formed by the fit of the pedestal in relationship to the wick holder, to enhance flow of fuel to the wick. Moreover, the wick holder is preferably configured so as to also engage the fuel element in a lock and key relationship and to position it on the melting plate in the preferred location.

[0030] Another embodiment is directed to the adjustability of the capillary nature of the gap formed by the gap between the pedestal and the wick holder, which may be controlled by rotation of a symmetrical wick holder about a non-symmetrical pedestal, or, conversely, by the rotation of a non-symmetrical wick holder about a symmetrical pedestal. As the wick holder rotates about the pedestal, if one is non-symmetrical, some areas of the two will come into closer proximity, while other areas are further apart, causing the degree of capillary flow to vary. By proper selection of the geometric configurations of the wick holder and the pedestal, it is possible to obtain a method by which one can rotate the wick holder in a given direction relative to the capillary pedestal to obtain a desired increase or decrease of flow of liquified fuel to the wick itself, and thus to effect a control upon the rate of consumption of fuel, and the height of the flame upon the wick.

[0031] A heat conductive element constitutes the melting plate itself, which may comprise portions formed, raised, or bent to be in closer proximity to the flame, such as a raised section of the plate, e.g., the upper edge of the raised side of the melting plate. For example, the melting plate may constitute a bowl shaped container having its outer periphery in close proximity to the flame, such as a container in which the side wall of the bowl is

formed so that the lip of the upper opening curves back toward the center of the bowl, and thus toward the flame. The melting plate may also have secondary heat conductive elements, such as one or more raised portions which act not only to absorb and distribute heat by conduction, but to channel or direct the flow of liquid fuel to the wick. Such raised portions may constitute areas of material having higher heat conductivity than surrounding areas of the container. In such examples, the support plate may comprise a less conductive material, such as glass, and the principal heat exchange may be by radiant heat and conducted heat by means of the secondary heat conductive elements of the wick holder. It may thus be seen that the wick holder assembly, comprising a wick, and a fuel element, in conjunction with a base configured so as to complimentarily engage a capillary pedestal, may be utilized in any candle container comprising a capillary pedestal.

[0032] In the present invention, a capillary pedestal both engages and positions the aforementioned wick, wick holder, and fuel element in such a manner as to provide the most advantageous positioning thereof, as well as to create a capillary flow of melted fuel from the melting plate to the wick positioned in the wick holder, which is placed in such close relationship to the capillary pedestal as to create a very narrow gap between the pedestal and the wick holder. By virtue of this narrow gap, which may be from approximately 0.01 to about 0.04 inches, preferably about 0.02 inches, liquefied fuel rises to the wick for consumption. If one of either the wick holder or the pedestal is "out of round", e.g. oval, it is clear that the capillary gap will not be uniform throughout its circumference about the pedestal. It should be noted that it is within the scope of the invention that the capillary action may be improved as a result of grooves cut in the pedestal, or in the wick holder, and that the wick holder may be held away from the pedestal by the presence of appropriately positioned and sized bumps located on either the pedestal, the wick holder, or the melting plate. In addition, another embodiment is directed to the concept of varying the capillary gap between the wick holder and the pedestal by means of rotation of the holder about the pedestal. Moreover, the capillary forming combination of elements may constitute a concave depression in the melting plate, rather than a raised male pedestal, and the wick holder in such case may be an appropriately shaped male member which fits closely within the depression so as to create a capillary gap between the members, by which fuel is fed to the wick, and having engagement

means to prevent its accidental removal from said depression. Still further, it is contemplated that the capillary pedestal, in a male configuration, or a female depressed configuration, need not constitute a circular member, but may be of any shape, such as for example cylindrical, pyramid shaped, square, oval, triangular, or any other desired shape, in combination with a like-shaped and appropriately dimensioned wick holder and locking means. In accordance with another embodiment, the wick holder and locking means need not be totally complimentary in shape to the pedestal or depressed area of engagement, but varies sufficiently to provide variance of capillarity between the two in different circumferential locations. It is also to be noted that the capillary pedestal need not transmit liquid fuel to the wick at all parts of the perimeter of the capillary pedestal. For example, a circular capillary pedestal in conjunction with a circular wick holder need only create a capillary gap for a limited portion of its circumference, such as for 90, 180, or 270 degrees. Thus, the wick holder need not be in a close enough proximity to the pedestal throughout the total area of engagement therewith to provide a full capillary effect, but only in sufficient area to provide an adequate flow of fuel to the wick to maintain the flame upon the wick. In another embodiment, the wick holder is rotated about the pedestal so as to change the degree of capillary flow achieved.

[0033] Additionally, primary heat conductive elements are separate assemblies which are utilized in conjunction with the melting plate and consumable wick and wick holder. The primary heat conductive element may take the form of heat fins or heat conductive surfaces attached to the wick holder, and having either vertical or horizontal orientation or elements of both. In preferred embodiments, such heat conductive elements are heated by direct contact with the flame, and conduct such heat to both the melting plate and to the fuel so as to more efficiently heat the fuel. The heat conductive elements of the wick holder, hereinafter exemplified as heating fins, although not limited to fins per se, and intended to encompass other heat conductive extensions of the wick holder which may serve this function, may be of any highly heat conductive material, and may be either formed as an extension of the wick holder or joined to the wick holder in such a manner as to conduct heat from the flame to that portion of the wick holder which is engaged by the capillary pedestal and/or the melting plate. The wick holder thus comprises fins, a means to hold the wick, the wick, and a base configured so as to engage the melting plate via a capillary pedestal or lobe, and to transfer heat

from the fins to the melting plate. Where plural fins are employed, which do not contact the flame itself, it is preferred to join the upper tips of such fins by means of a highly heat conductive element, such as a metal wire or metal connecting piece. Suitable and exemplary, although clearly not the only possible heat fins are illustrated in US Patent 6,780,282, issued August 24, 2004. Moreover, the fins should be insulated in that region below the flame in which they are exposed to the ambient atmosphere, so as to prevent radiation and loss of heat to the surrounding area.

[0034] It is to be understood that the wick holder and associated primary heat conductive elements are meant to be so situated and shaped as to engage or interlock with a replaceable solid fuel element. In a similar fashion, the melting plate and/or the fuel container may be formed in such a manner as to permit placement of fuel elements of specific configuration, such as wax pucks having a complementary configuration, for example, in a preferred position in proximity to the heat conductive elements themselves, or to the wick holder, in such a manner as to maximize heat transfer from the melting plate to said fuel elements. In an embodiment, additional heat conductive elements are present as an element of the wick holder, in the form of extending legs or leaves from the base of the wick holder into the body of the solid fuel element. A capillary pedestal is present on the melting plate, positioned in such a manner as to also transfer heat to the fuel element, and configured so as to engage a wick holder holding a consumable wick and having one or more heat conductive fins, and a fuel element such as a wax puck. Further, the engagement of the wick holder with the capillary pedestal is such as to provide a capillary effect between the two for feeding fuel to the wick. In this embodiment, the consumer may purchase a replacement fuel element comprising a wax puck and a wick holder and wick, configured so as to engage a matching capillary pedestal on the melting plate in such a manner as to position the fuel element and the wick holder, and having a heat conductive element in the appropriate location to most efficiently melt the fuel element. Alternatively, the consumer may purchase an assembly comprising a wick holder and wick, with separately available appropriately shaped fuel elements.

[0035] The use of the melting plate technology of the present invention may also provide such advantages as elimination of tunneling, significant reduction of retention of wax

at the conclusion of the burn, and elimination of walking or off-center wicks, while also giving a larger pool of liquid wax with a relatively small flame in a relatively short time period. In addition, the container may be of almost any shape desired, providing for great aesthetic possibilities. Since the fuel element, either alone or in combination with a wick and wick holder, may be provided as a separate unit, the consumer may be provided a great number of choices as to the color, content, and nature of the fuel, and the configuration of the fuel element may be varied to provide a large choice of shapes, such as seasonably decorative items. For example, shapes such as pumpkins may be provided for Halloween, wreaths for Christmas, and flowers for all seasons. In addition, the fuel element preferably is configured as to cooperatively engage both the melting plate and the wick holder, which wick holder in turn engages the capillary pedestal on the melting plate, in such a manner as to provide the consumer the greatest degree of ease in placement of the fuel element in optimal position in the melting plate candle, with the least possibility of incorrect placement. Further, the melting plate or support plate may have decorative features, such as designs, embossed, etched, printed, or stamped thereon.

[0036] Accordingly, the present invention provides a melting plate candle, wherein said candle comprises a container for a fuel element comprising a fuel selected from the group consisting of paraffin, beeswax, montan wax, carnauba wax, microcrystalline wax, polyvinyl acetate, fatty alcohols, fatty acids, fatty esters, and gels incorporating such fuels, in a form selected from the group consisting of pucks, donuts, chips, slivers, balls, pellets, shavings, particulates, cubes, discs, three dimensional shapes, and wafers, or in any other suitable shape. The fuel element may optionally further comprise such volatile active materials as fragrances, air fresheners, deodorizers, odor eliminators, odor counteractants, insecticides, insect repellants, herbals, medicinal substances, disinfectants, sanitizers, mood enhancers, aroma therapy compositions, and the like. Such solid fuel may be colored for decorative effect, if so desired, and may be shaped to fit any given configuration of melting plate and/or wick holder. For example, the bottom of a solid fuel element should be curved complementarily to the shape of the melting plate upon which it is to rest, and have melting temperatures above ambient, but below the flame temperature of a wick burning such fuel.

[0037] These and still other advantages of the present invention will be apparent from the description which follows, which description is merely of various embodiments, and not indicative of the full scope of the invention.

[0038] FIGS. 1 and 2 illustrate the broad concept of a melting plate candle in its most basic form, such as set forth in U.S. Patent 6,802,707, issued October 12, 2004. The teachings of said pending patent application do not illustrate the capillary pedestal and wick holder assembly of the present invention, nor the primary heat conductive members comprising heat fins passing through the hottest region of the flame with regions thereof insulated to prevent heat loss to the atmosphere. As illustrated, a heat conductive melting plate container 2 is provided, which transfers heat obtained from the heat source, a flame (not shown) located on wick 3 by means of heat conduction, to the solid fuel element 4, which rests upon the surface of the melting plate. For purposes of illustration, and for clarity, but intending no limitation, the wick is illustrated in FIGS. 1 and 2 as being of a relatively large diameter, rather than as a fibrous wick of small diameter. It is to be understood that the wick is positioned within and attached to the solid fuel element 4 such as with a wick clip (not shown in FIGS. 1 and 2). The melting plate 2, as shown in FIGS. 1 and 2, is heated directly by a flame on the wick 3 by radiation, as a result of the melting plate being shaped so as to have a portion, shoulder 18, in proximity to the flame, the diameter of the melting plate bowl being such as to permit the inner surfaces thereof to absorb appreciable amounts of heat from the flame.

[0039] The melting plate of FIGS. 1 and 2 is shaped so as to have a raised outer shoulder 18 thereby containing the resultant pool of melted fuel. It is to be understood that the melting plate may be in the form of a tray, bowl, concave plate, or other configuration which is capable of holding a pool of hot liquid fuel, and is preferably shaped so as to funnel or channel the liquefied, i.e., melted, fuel to the wick. The melting plate may constitute a container in itself, as shown, or may be surrounded by a separate container. In the embodiment shown in FIGS. 1 and 2, the melting plate rests upon a non-conductive base 11 or legs of non-conductive or insulating material, so as to permit placement upon a table, counter, or other surface. The non-conductive base, as illustrated, comprises contact points 12 so as to minimize the amount of contact between the base and the melting plate, and to create an

insulating air gap 13 between the melting plate and the surface upon which the assembly rests.

[0040] The melting plate may be of any heat conductive material, such as brass, aluminum, steel, copper, stainless steel, silver, tin, bronze, zinc, iron, clad materials, heat conductive polymers, ceramics, glass, or any other suitable heat conductive material or combination of such materials. As shown in FIG. 2, the fuel is preferably located in direct contact with the surface of the melting plate 2, which plate may, if desired, be constructed so as to have a non-conductive lower surface, so that the melting plate may rest upon a table surface or such. Such a configuration may result from a clad material, a conductive melting plate material coated on the external surface with a non-conductive material, a non-conductive material having an insert of a heat conductive material, or other suitable arrangements to permit the melting plate to be cool enough on the bottom surface to permit ease of handling, and/or placement upon surfaces not suitable for contact with heated bodies.

[0041] The wick 3 preferably constitutes a conventional consumable wicking material, such as such as cotton, cellulose, nylon, or paper, or the like, which by capillary action will carry liquid fuel to the flame. Alternatively, non-consumable wicks may comprise such materials as porous ceramics; porous metals; fiber glass; metal fiber; compressed sand, glass, metal, or ceramic microspheres; foamed or porous glass, either natural or man-made, such as pumice or perlite; gypsum; and chalk. However, for purposes of the present invention, the use of conventional consumable wicks is preferred. The wick 3 may be located in the center of the melting plate 2 or may be off-center as desired, provided that the melting plate is configured so as to channel or funnel melted fuel to said wick. As illustrated, the wick may be positioned in conjunction with a starter bump 6 of wax in the top surface of the fuel element 4 for ease of lighting. The presence of two or more wicks is also within the scope of the present invention. The wick is provided in conjunction with the wick holder assembly, the preferred configuration of the wick holder being such as to cooperatively engage a complimentarily shaped capillary pedestal 22 on the melting plate, as shown in FIGS. 3, 4, and 5, discussed hereinafter.

[0042] FIG. 3 illustrates a melting plate container 2 comprising a concave base, and having a raised pedestal or protrusion 22 located near the center thereof, the pedestal being

shaped so as to engage the legs or skirt 23 of a wick holder 7. The wick holder itself is comprised of a central wick holding means 5, a wick 3, and heat fins 9 located so as to absorb heat from a flame 1 upon the wick mounted in the wick holder, and to permit flow of the heat from the flame to the base of the melting plate container 2 and to the solid fuel element 4. The tips of the wick fins are joined by a highly conductive wire 8 or other highly conductive means. Further, the fins are provided with insulated areas 10 between a point below the contact of the fin with the flame, or below the point of joinder by the conductive wire, to a point near or below the surface of the solid fuel element. The legs or skirt 23 of the wick holder fit in close proximity to the sides 24 of the pedestal 22, and engage an undercut 25 in the side surface of said pedestal, by means of shoulder 26 in such a manner as to resist removal there from. The legs or skirt 23 and the base 27 of the wick holder and the sides 24 and top 28 of the pedestal are in close proximity, so as to permit maximum resistance to separation, and so as to create a gap resulting in a capillary flow of melted wax from the bottom of the melting plate container 2 to the top of the pedestal 28. In addition, highly heat conductive leaves or branches 16 extend outward from the bottom of the wick holder into the body of the fuel element, so as to assist in rapid melting thereof. Such leaves or branches are preferably of the same material as the base of the wick holder. The bottom 27 of the wick holder is shown to be in close proximity to the top 28 of the pedestal, assuring a rapid and even flow of liquefied fuel to the wick, held in position so as to contact the fuel by wick holding means 5. Although the invention 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.

[0043] In FIG. 4, an exploded perspective view of the invention is shown, with a bowl shaped melting plate container 2, which comprises a capillary pedestal 22 located in approximately the center thereof. A wick holder 7 is shown above the capillary pedestal, the wick holder being shaped in such a manner as to fit closely over the capillary pedestal and to tightly engage an undercut therein so as to be locked in position. The wick holder, as illustrated, further comprises the wick 3, heat fins 9 joined by wire 8, and a heat conductive leaf or wing 16. A solid fuel element 4 is shown, having a cut out portion 6 through which the heat fin and wick assembly may pass, so as to place the wick in close proximity to the top surface of the fuel element. The solid fuel element is shown as a wax puck, although other

shapes may clearly be used within the scope of the present invention. To prevent difficulty in lighting the wick, a starter bump of fuel may be provided in close proximity to the wick 3. As illustrated in FIGS. 1 and 2, this bump is most easily molded directly into the shape of the fuel element, and provides a ready source of liquid fuel to the wick when a match or other appropriate source of flame is employed to start the wick burning, which source of flame will melt the starting bump to thus create an initial pool of liquid fuel.

[0044] FIG. 5 shows the embodiment of FIG. 4 in operational configuration, showing the relationship of the elements in position for lighting of the wick 3, wherein the melting plate 2 is shown with a fuel element,4 positioned on the capillary pedestal (22, not visible) and centered around a wick holder assembly with the heat transfer fin 9 and wick 3 extending through the opening 30.

[0045] FIG. 6 illustrates the specific concept of an embodiment, in which the flame 1 is in close proximity to fins 9 and wick holder 7 is shown to be rotatable about the perimeter of the capillary pedestal (not shown) by means of lever 14.

[0046] Thus, when using a solid fuel, such as wax, in conjunction with a heat conductive wick holder, solid fuel refill units may be shaped to fit the shape of the melting plate, with a specific relationship to the wick holder, which itself is engaged with the melting plate by a locking means. For example, the melting plate may be a decoratively shaped container, and wax may be provided in the form of refills specific for the container shape selected, such as round, square, oval, rectangular, triangular, or otherwise, so shaped that the wick holder assembly incorporated with the wax refill unit will fit and engage a complementarily shaped capillary pedestal. In another embodiment, the wick holder assembly fits the capillary pedestal in such a manner that the capillary gap between the two may be varied by rotation of the wick holder relative to the capillary pedestal.

[0047] The use of a melting plate with additional heat conductive elements, such as the partially insulated heat fins and joining wire illustrated, offers a number of distinct advantages. First, it permits a larger pool of liquid fuel, due to improved heat conduction into the fuel, which results in more rapid formation of the pool. This in turn allows better regulation of the size and shape, as well as the temperature, volume, and depth of the liquefied wax pool to allow more efficient use of fuels present. In fact, melting plates of the

present invention permit ease of refill, with little or no cleaning. In most instances, no cleaning is required, but if desired, the plate may be conveniently washed in a manner such as a dish, plate or bowl is washed, in a wash basin or in a dishwasher. The use of a capillary pedestal in the heat plate, in conjunction with heat fins on the wick holder, also reduces or eliminates retention of solidified excess fuel when the candle is allowed to burn itself out, and permits more complete and uniform burning of fuel elements which are other than round, i.e. square, oval, triangular, or in the shape of a flower or decorative object, etc. Further, the melting plate technology in conjunction with a capillary pedestal and complimentary wick holder, results in devices which may be self extinguishing, and improvements in or elimination of typical burning problems encountered with candles, such as tunneling, drowning, collapsing, cratering, and wick drift. Candles utilizing the melting plate technology of the present invention are also more forgiving of formulation or process variances. And, more importantly, the presence of a locking configuration of the wick holder and the capillary pedestal provides a margin of safety and convenience not previously available. Still further, the rotational means to control the capillary gap, and thus the flow of melted fuel, between the pedestal and the wick holder, is not limited to melting plate candles which employ insulation of portions of the wick fins or a joining wire between the fins, but is applicable to any melting plate configuration employing a capillary or centering pedestal and a wick holder assembly.

[0048] While the present invention has been described with respect to what are at present considered to be the preferred embodiments, it is to be understood that the invention is not to be limited to the disclosed embodiments. To the contrary, the invention is intended to cover various modifications and equivalent arrangements within the spirit and scope of the appended claims. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent formulations and functions.

INDUSTRIAL APPLICABILITY

[0049] The melting plate and heat conductive element candles of the present invention, utilizing a capillary pedestal and correspondingly shaped locking wick holder having fins which contact the hottest portion of the flame upon the wick, but are elsewhere insulated

to prevent heat loss, can be used in connection with a large variety of solid fuels. The conductive materials of which the melting plate and heat fins may be constructed are commonly available, and the various configurations are readily produced. There is considerable interest for candles having extended burn times, and for refillable candles or solid fuel lamps, particularly for melting plate candles which are resistant to accidental release of the wick holder assembly.

Claims

1. A replaceable fuel element adapted for use with a melting plate candle, the replaceable fuel element comprising a solid fuel material cooperatively engaging a wick holder comprising a wick, the wick holder configured so as to lockingly engage a capillary pedestal on the melting plate candle, and further comprising heat fins which pass through a flame upon the wick and conduct heat from the flame to the replaceable fuel element by means of one or more branches which extend outward from the fins into the replaceable fuel element, wherein the fins are insulated so as to inhibit heat loss between the flame and the replaceable fuel element.

2. The replaceable fuel element of claim 1, further comprising a volatile material.

3. The replaceable fuel element of claim 2, wherein the surfaces of said fins are insulated so as to inhibit loss of heat to the atmosphere.

FIG. 1 PRIOR ART

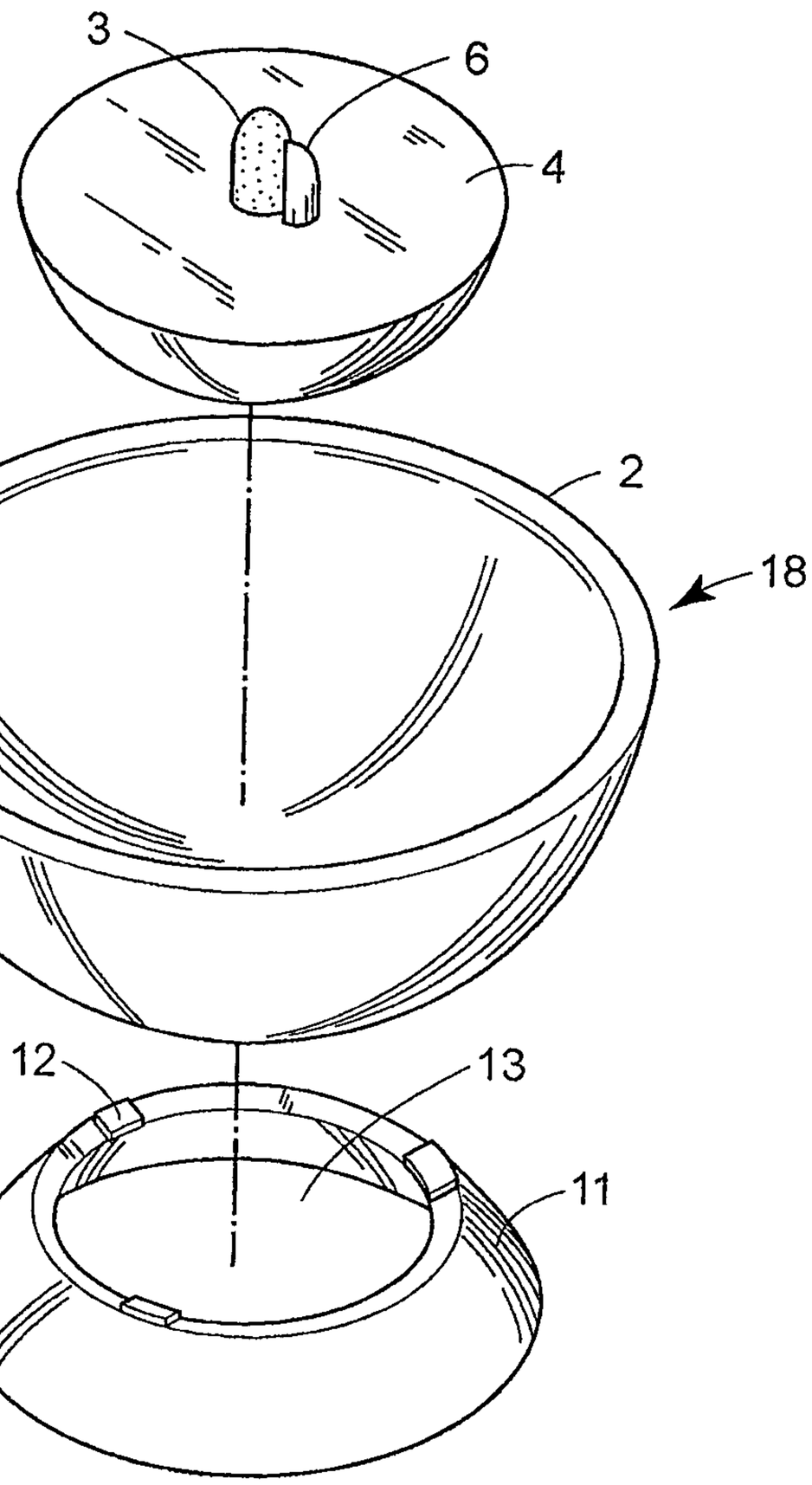


FIG. 2

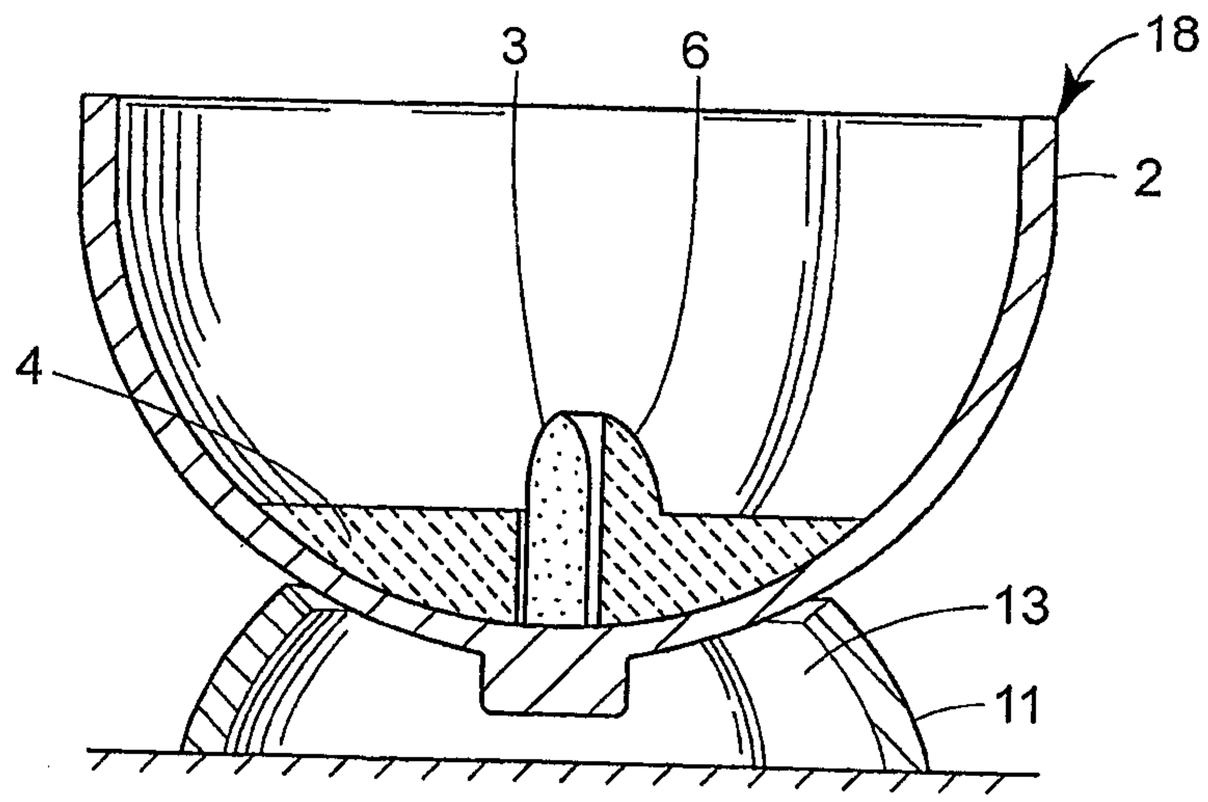


FIG. 3

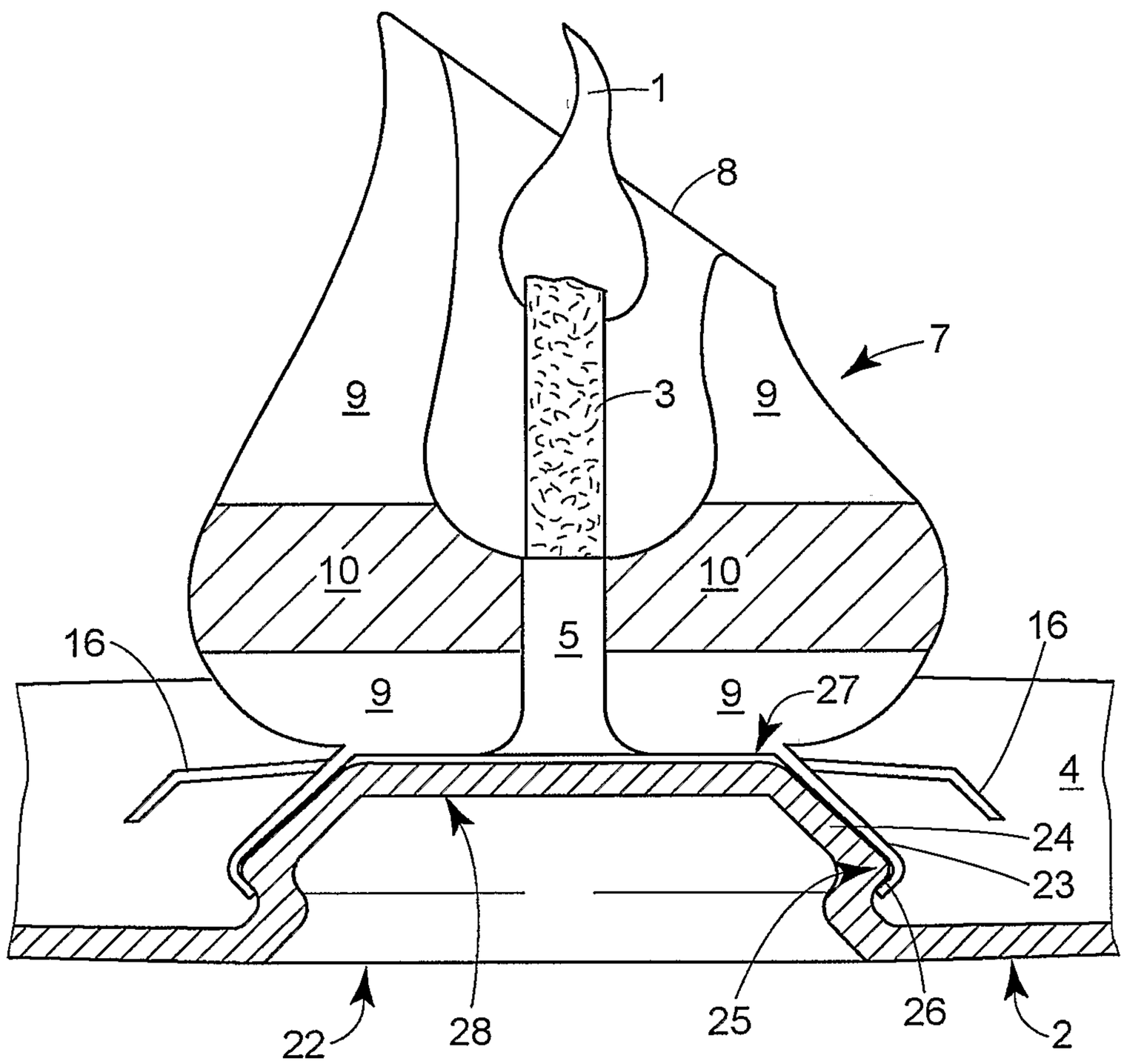


FIG. 4

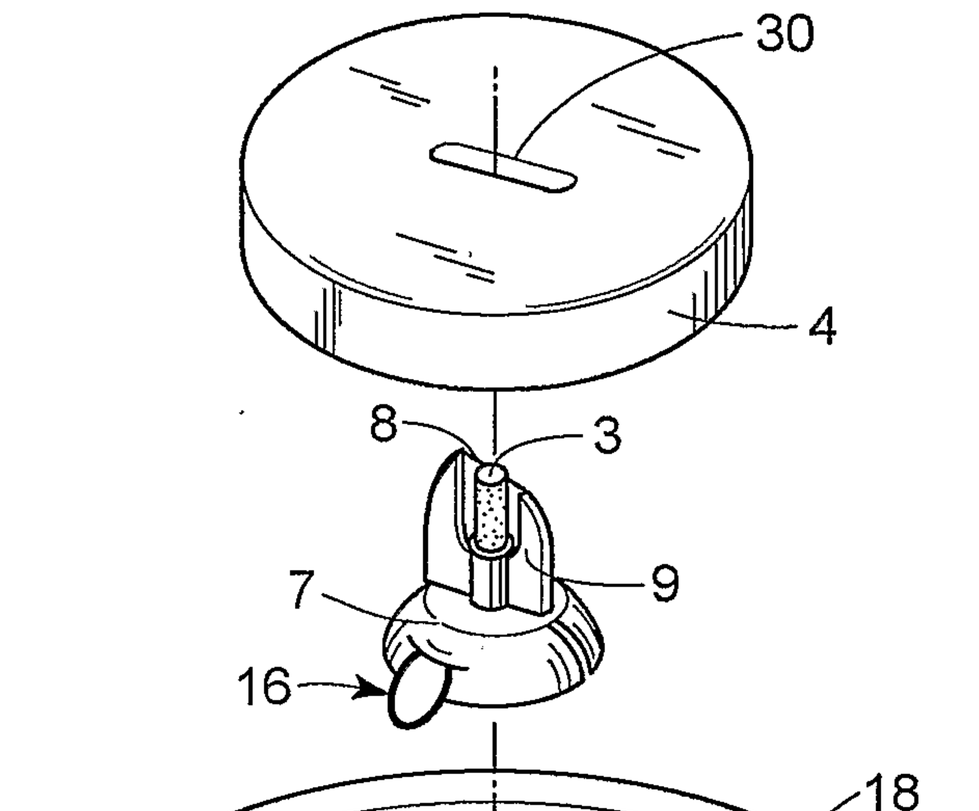


FIG. 5

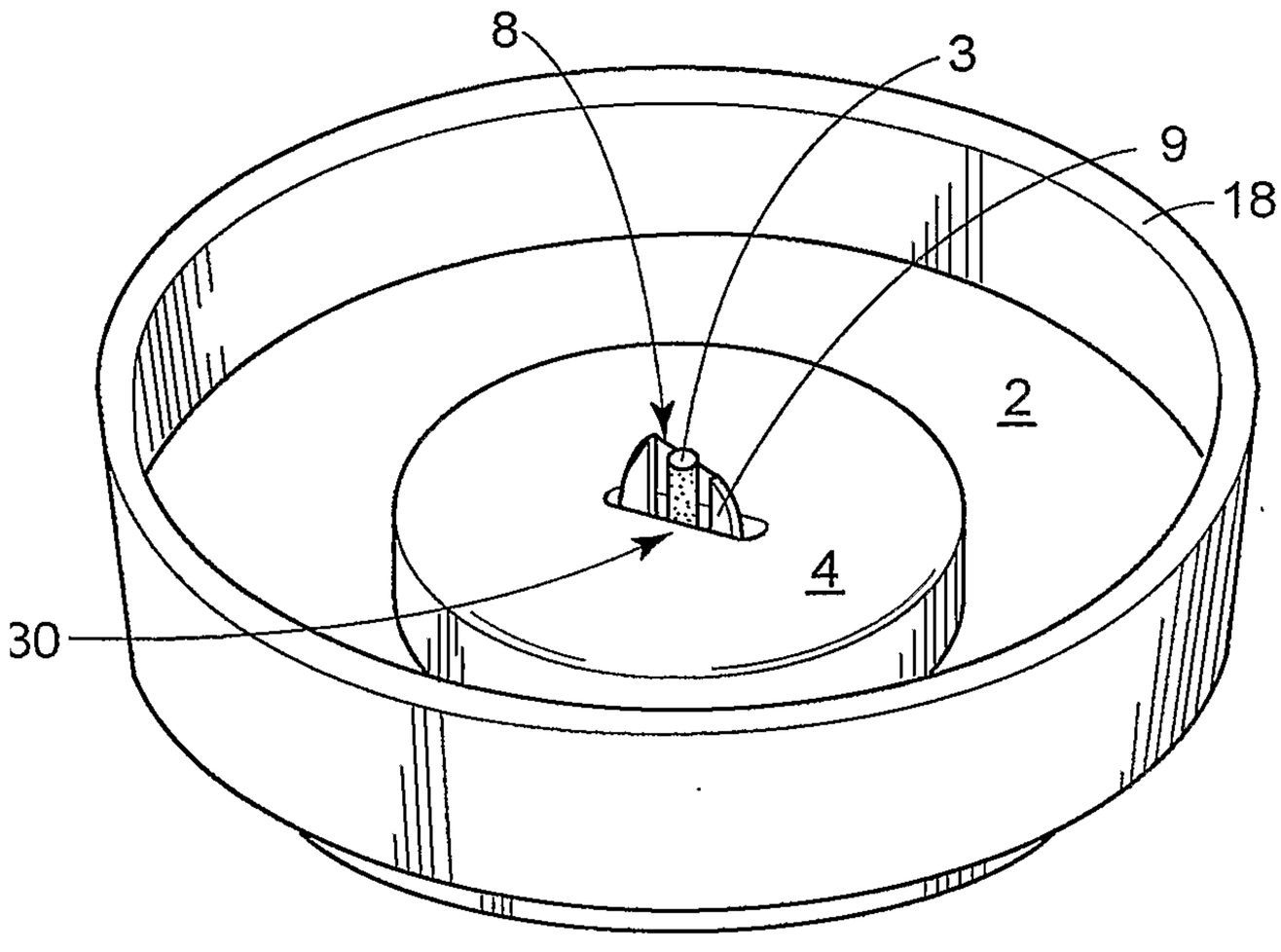
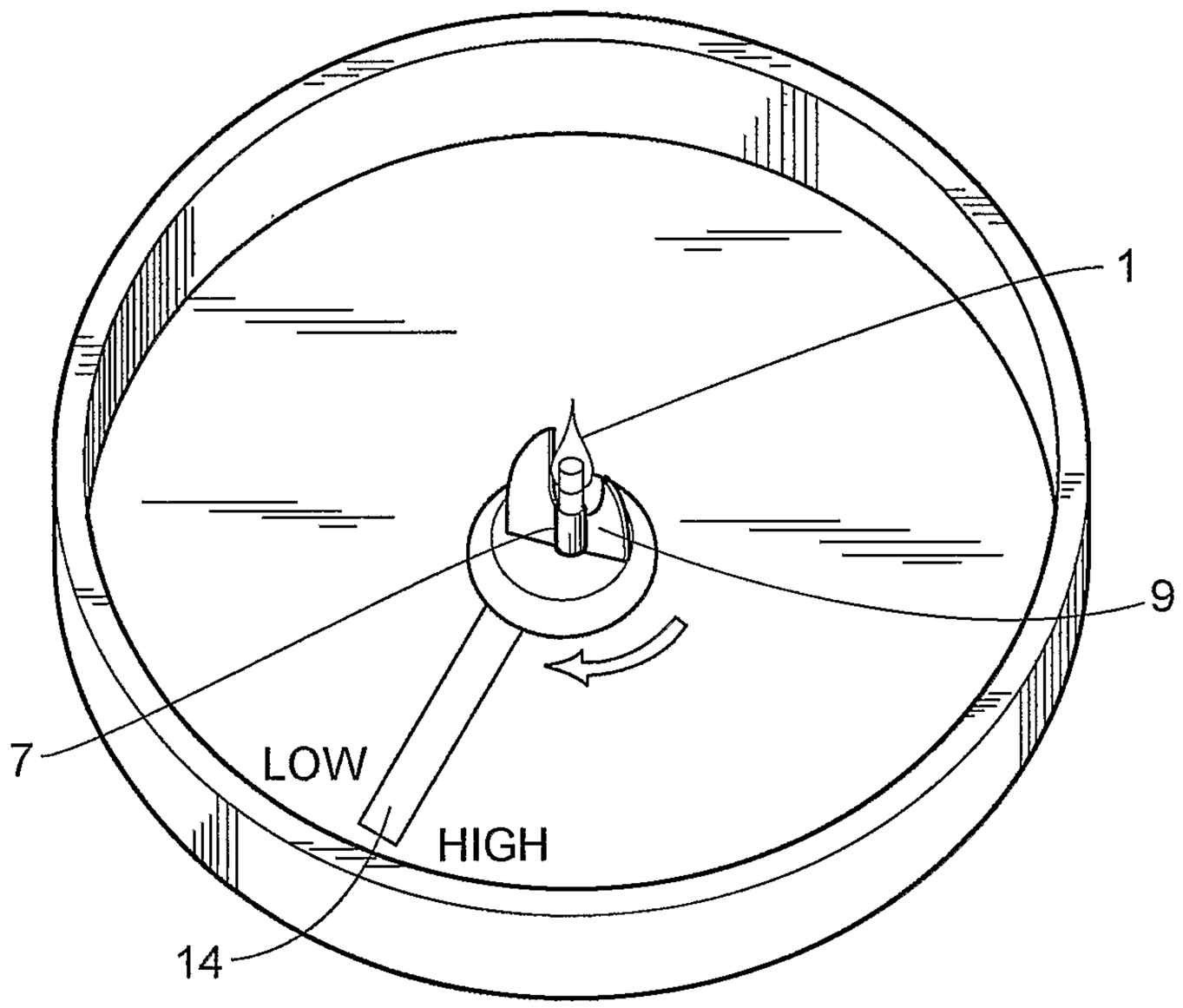
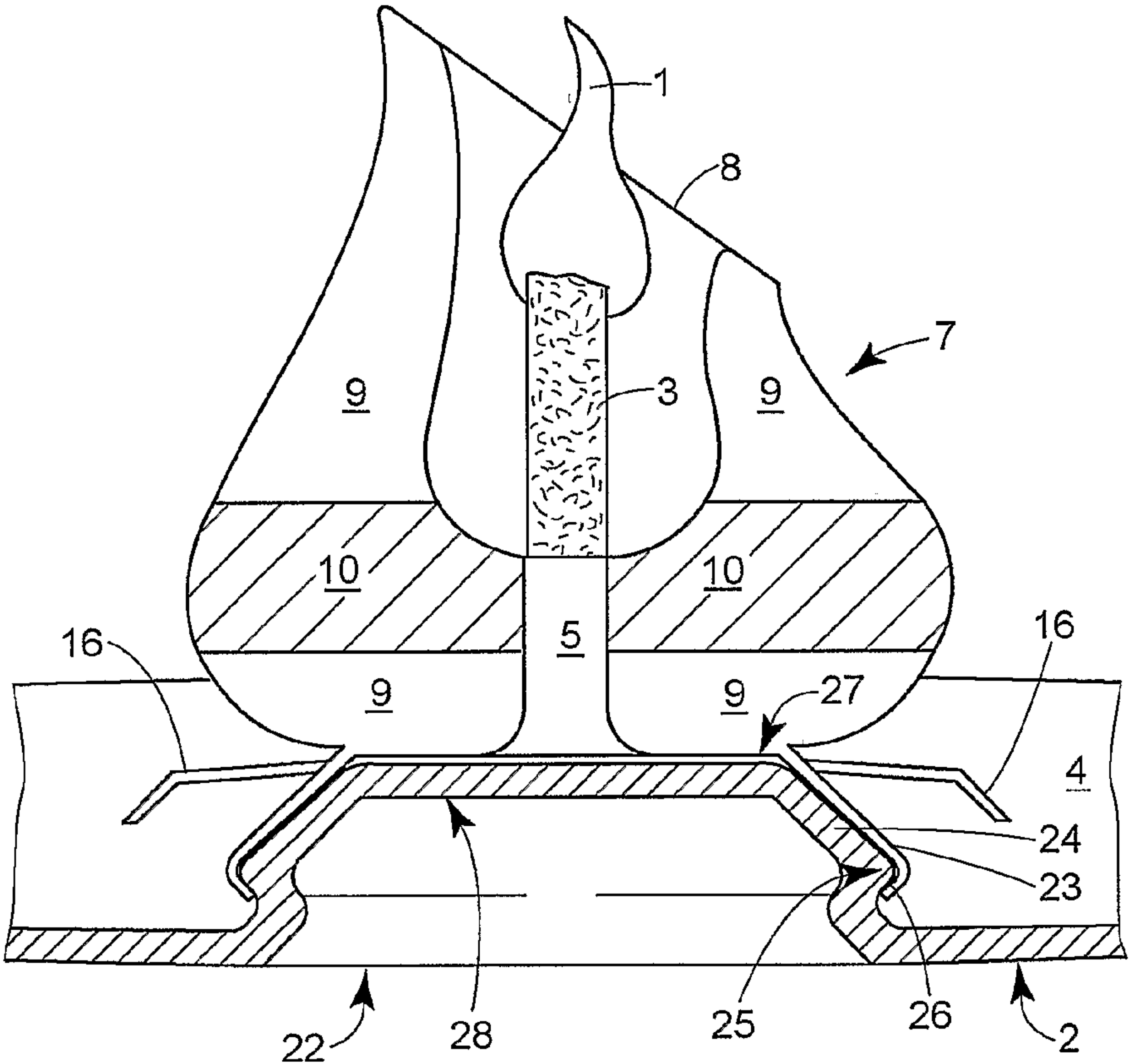


FIG. 6




1
8
7
9
3
9
10
10
5
16
16
9
9
27
4
24
23
22
28
25
26
2