WAX BURNERS

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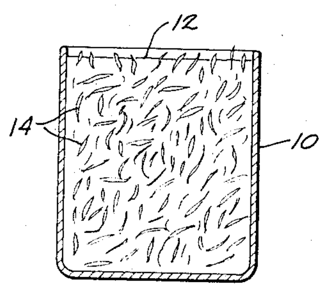

Fig. 1

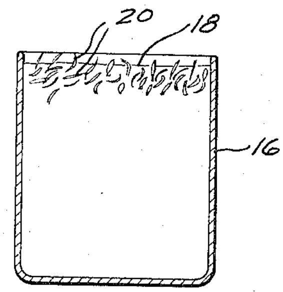

Fig. 2

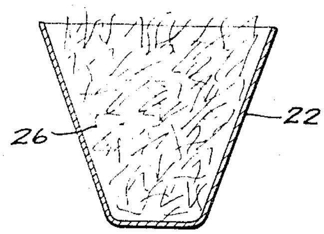

Fig. 3

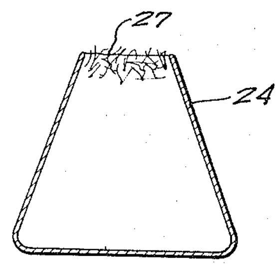

Fig. 4

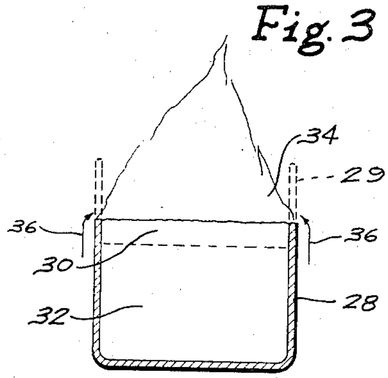

Fig. 5

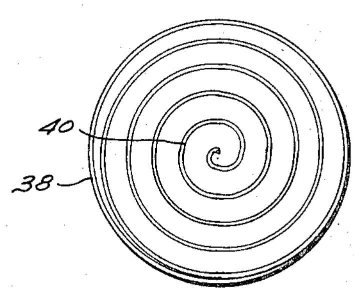

Fig. 6

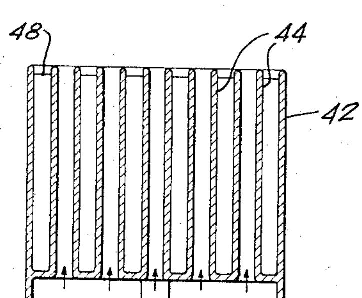

Fig. 7

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WAX BURNERS

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This invention relates to process and apparatus involving wax burners adapted for use as heaters and particularly adapted for use as orchard or grove heaters.

In the prior art wax candles have primarily been utilized to provide artificial light and have generally been inadequate in heat output for use specifically as heaters. Therefore, wax candles have not heretofore been practical for use as heaters for protecting orchards or groves from damage due to cold weather. The present invention relates to wax candles having a substantial heat output which renders them practical and advantageous for use as orchard or grove heaters.

The conventional wax candle comprises a slender, elongated, wax cylinder having a wick extending longitudinally therethrough. When the wick is ignited combustion occurs solely at the terminus of the wick. Throughout the operational life of the candle the flame at the wick provides heat of fusion to the wax around the wick to transform the wax from the solid to the molten state so that the molten wax can flow by capillary action and surface tension up the wick and into the flame. As the molten wax in the wick flows into the bottom of the flame, the flame provides heat of vaporization to transform the molten wax to the vapor state. A liquid must be vaporized in order to burn and the vapors rise into the flame to maintain combustion. The heat of combustion of the vapors in turn melts more of the wax around the wick to continue the cycle.

If the wick produces too small a flame in relation to the surface area of the candle, only sufficient heat will be generated to satisfy heat of fusion requirements of the wax in the central region of the candle and only the wax in the central region of the candle will melt while the wax at the periphery of the candle will remain solid. Since only melted wax will flow up the wick and burn, the flame will create a crater in the center of the candle into which the flame will gradually descend. Ultimately, molten wax flowing down the sides of the crater will drown the wick and extinguish the flame.

On the other hand, if the wick produces too large a flame in relation to surface area of the candle sufficient heat will be generated to more than satisfy heat of fusion requirements of the wax along the entire upper surface of the candle and the wax along the upper surface of the candle will melt faster than it can be drawn by capillarity up the wick and burned. The excess molten wax will tend to drip down the sides of the candle, leading to wastage of wax and distortion of the candle.

It is apparent that in a conventional candle the relation of the size of the wick to the diameter of the candle is highly important. If the wick is too small in relation to the diameter of the candle the flame will form a crater in the wax, descend thereinto and be smothered by molten wax while if the wick is too large in relation to the diameter of the candle molten wax will drip from the edge of the candle and the candle will become distorted.

The wax burner of the present invention avoids the difficulties imposed by improper relative size of wick to wax by avoiding utilization of a wick in the conventional manner. In a burner of the present invention, a single wick is not utilized but rather a diffusible easily ignitable material is dispersed substantially uniformly within the wax throughout its cross-section at least in the upper region thereof where it protrudes from the wax at a plurality of points for ignition by an external ignition means. Following ignition of the uniformly dispersed ignitable material the flame diffuses across the entire cross-section at the top of the candle, as contrasted to a narrow localized flame where only a central wick is employed, and a blanket of heat is transmitted downwardly over the entire upper layer of the wax. Since the igniter material is sufficiently diffused so that the flame produced therefrom covers the entire surface of the wax, the heat radiated downwardly is not only substantial in quantity but also is insulated against loss by the flame so that sufficient heat is absorbed and retained by the surface of the wax to supply the requirements for both heat of fusion and heat of vapor ization of the entire upper surface of wax in the burner. Wax vapors rise from the entire upper region of the wax to support a broad and expansive flame.

Since wax vapors from the entire upper surface of the wax continuously rise into the flame, in accordance with the present invention, the flame is maintained without being delimited by the rate of capillary flow of liquid wax along a wick. The rising vapors of wax provide an expanded and relatively massive supply of fuel to the flame as compared to a conventional candle wherein the supply of fuel to the flame is restricted to the capillarity rate of wax flow through a wick, the wick itself being a negligible source of fuel. In the wax burner of the present invention, the quantity of igniter material is sufficiently great so that upon ignition thereof the amount of heat radiated to and absorbed by the wax is sufficient to maintain the entire upper surface of the wax at its kindling temperature, which is generally about 450° F. to 650° F. for petroleum waxes melting at about 120° F. to 175° F. Upon achieving its kindling temperature, the wax maintains its own combustion and the use of an igniter material is no longer required. Therefore, the igniter material of this invention is only needed for initiating combustion but is not required for maintaining combustion once the wax reaches and maintains its kindling temperature. For this reason, the igniter material need only be diffused over a shallow upper layer in the wax in the burner of the present invention. A thin layer of igniter material has satisfied its purpose after it has initiated combustion and the flame has become self-sustaining.

In manufacturing a burner of the present invention, igniter material is disposed within a combustible container or receptacle which is open at the top and molten wax is then poured into said container. The diameter or average lateral dimension of the vessel is advantageously large as compared to its height and can be as large or larger than its height. The use of a container in accordance with this invention permits manufacture of a burner in which igniter material is dispersed throughout the wax. Moreover, a container for the wax is required in accordance with this invention because the surface pool of molten wax which forms during combustion would otherwise flow down the sides of the yet unmelted wax. A container is also required for purposes of storing and stacking of the burners prior to combustion to prevent distortion resulting from plastic flow characteristics of wax caused by warm storage temperatures and pressures from stacking.

It is critical that only a combustible container be utilized whose sides burn and are maintained continuously at or slightly above wax level during combustion, in order to permit access of atmospheric air to the flame during operation of the burner. If a noncombustible container were utilized, once the level of the wax had lowered in the container during combustion, rising combustion products would prevent inflow of air to the flame whereby the flame would become smoky and gradually smother. On the other hand, when the level of a combustible container wall lowers at substantially the same rate as the level of the wax, in accordance with the present invention, a steady and even supply of air is permitted to flow in a natural convection current upwardly along the sides of the container and into the flame. A suitable container material is a nonporous hardboard kraft paper. A nonporous paper is desired since any heating of solid wax, such as by warm storage temperatures, frees oils trapped within the wax and these oils would tend to seep through a porous container. Also, when the candle is burning the melted wax below the immediate burning surface would seep through a porous container and run down the sides.

Various types of petroleum waxes or blends thereof are suitable for use in burners of this invention. For example, advantageous results are achieved with the following waxes or wax blends: heavy neutral slack wax; 150 bright stock slack wax; blends of heavy neutral slack wax and 150 bright stock slack wax in all proportions; and blends of heavy neutral slack wax and 150 bright stock soft wax containing 50 percent or more of heavy neutral slack wax. Although asphalt cannot be substituted for wax in the burners of the present invention because it is extremely difficult to ignite initially, because it does not maintain its own combustion in the small burners of the present invention once ignited, and because it leaves heavy carbon deposits upon combustion which retain the shape of the container, it was found that the burners of the present invention can tolerate a minor proportion, such as, for example, up to about 25 percent by weight of asphalt blended with the wax. It was found that small amounts of asphalt in wax reduce fuel consumption rate and therefore asphalt has utility as a blending agent in wax grove burners which are to be utilized at small trees requiring a small flame size to avoid scorching. However, a disadvantage of the wax-asphalt blends is that they become excessively soft at elevated storage temperatures so that they are highly inferior to asphalt-free wax burners in this regard.

Additives can be incorporated into the wax to improve the burner in various ways, such as, for example, by thickening the wax, improving combustion, or reducing smoke. Whatever additive is used is generally mixed into molten wax prior to manufacture of a burner of this invention. A wax thickening agent may be required in a wax of high oil content since a high oil content lowers the melting point and sweating point of wax and greatly reduces its resistance to flow during elevated temperatures of transportation and storage. It was found that 12-hydroxy stearic acid and aluminum stearate significantly improve wax flow resistance by imparting an observable gelling or thickening effect to wax at a temperature of 110°F.

The use of additives for reducing smoke output in the wax burners of this invention can be important in view of the prevalence of smoke control ordinances. However, since smoke depressants generally leave a solid residue, in order to qualify for use as an additive such wax smoke depressants should reduce smoke significantly at concentrations in the wax of 0.1 weight percent or less to avoid appreciable lowering of the burning rate of the wax as a result of deposit formation at the burning surface. Dicyclopentadienyl iron, more commonly known as ferrocene, in the absence of other additives, was found to reduce smoking significantly when used at a concentration as low as about 0.01 percent by weight or less. Although most of the ferrocene molecule is vaporized during combustion, a residue comprising iron or iron oxide remains.

Even though smoke depressants and combustion improvers generally leave some residue upon combustion, they can still be advantageously utilized in the wax of the burners of this invention because of the absence of a wick and the resultant relatively great combustion surface area of these burners. In contrast, residue forming additives cannot advantageously be utilized in a conventional wick-type wax burner since in conventional wick-type burners combustion occurs only at the wick and depends upon capillary flow of wax up the wick. Residue formation in the wick of a conventional candle causes the wick to quickly become plugged, resulting in obstruction of capillary wax flow through the wick and severe retardation in combustion rate. In contrast, in the wick-free burner of the present invention there is no wick to inhibit combustion rate and combustion surface area is relatively massive rendering the burner substantially unaffected by moderate residue formation, thereby permitting residue forming combustion improver additives to be advantageously incorporated into the wax.

The burner of the present invention provides a much higher rate of heat output than a conventional candle. It is easy to store, stack and transport. It can be ignited in about one second. The burner is substantially completely consumed during the combustion process and substantially no residue or ash remains; the wax, the container and the igniter material all being combustible. The wax combustion rate in a burner of the present invention is substantial. It is optional whether the height of a burner is greater than its diameter or the reverse. An advantageous burner has been prepared which is about 7 inches high and has a wax diameter of about 9 inches which burns at the rate of more than two pounds of wax per hour. Such a burner produces a flame height of about 7 inches, which increases to 1 to 1.5 feet in strong gusts of wind. A suitable wax burner of this invention has about a 70 square inch combustion surface area and produces a heat output of about 50,000 B.t.u. per hour, or more than about 20,000 B.t.u. per pound of wax.

Because the burner of this invention utilizes a solid fuel it is especially useful as an orchard or grove heater. For example, if an animal tipped a burner on its side in a grove the fuel would not flow away from the burner and spread the flame as would occur with a liquid fuel but rather combustion would remain localized at the burner and would continue until the entire burner is consumed by the flame.

The wax burner of this invention will be more completely understood by reference to the accompanying drawings in which FIGURES 1, 2, 3 and 4 are side sectional views of various embodiments of wax burners of the invention, FIGURE 5 illustrates combustion with a wax burner, FIGURE 6 is a top view of a wax burner wherein an extension of the container itself is coiled through the wax to serve as an igniter, and FIGURE 7 shows a burner having means to supply air to the center of the flame.

FIGURE 1 shows a nonporous hard paperboard wide-mouthed container **10** filled with petroleum wax to the level **12**. An igniter material **14** is uniformly dispersed throughout the wax with some of said material extending above the surface of the wax to permit ignition thereof by contact with external ignition means such as a spark or flame. The igniter material can be excelsior, straw, wood chips, shredded paper or any other dispersible ignitable material. Igniter material **14** is added to container **10** prior to addition of molten wax thereto. Therefore, the igniter material should be capable of resisting compression by the molten wax so that it will not compact at the bottom of the container but rather will remain dispersed throughout the container upon addition of wax thereto. Excelsior and straw are highly suitable igniter materials in this regard.

FIGURE 2 shows a combustible container **16** filled with wax to level **18**. Igniter material **20** is dispersed only in the upper layer of the wax since it is required only for initiating combustion with the burner. The burner of FIGURE 2 can be prepared by first filling most of the container with a first portion of molten wax and permitting that portion of the wax to cool and solidify. Thereupon, a thin layer of igniter material is spread over the solid wax followed by the pouring of a second portion of molten wax over said igniter material until the container is filled to level 18. In this manner igniter material 20 is only dispersed over an upper layer of wax in the burner. As shown in FIGURE 2, igniter material 20 protrudes above wax level 18 at a plurality of points.

FIGURES 3 and 4 show tapered combustible burner containers. Container 22 is tapered to provide a progressively decreasing combustion area whereby the rate of heat output from the burner will progressively decrease during use. Container 24 is tapered in an opposite direction to provide an increasing combustion area whereby the rate of heat output from the burner progressively increases during use. An igniter material 26 such as straw is dispersed throughout the container of FIGURE 3 while an igniter material 27 is dispersed along only a shallow upper layer of the wax in the burner of FIGURE 4.

FIGURE 5 illustrates a burner of this invention during combustion. As indicated by the dashed lines 29 the sides of container 28 have burned down to the level of the wax. A molten pool of wax 30 overlays the remaining solid body of wax 32. Heat radiated downwardly from flame 34 causes vapors of wax to continually rise from the top of molten wax reservoir 30 to sustain the flame. Atmospheric air flows up the sides of container 28 into the flame along the path indicated by arrows 36.

FIGURE 6 shows a top view of an embodiment wherein an extension of a combustible container 38 serves as an igniter material. The container wall is extended so that it winds toward the center of the container to form a spiral 40 and molten wax is poured between the convolutions of the spiral. The container itself thereby constitutes an extended ignited material obviating the use of an extraneous igniter material. Any igniter material other than an extension of the container wall which spirals substantially continuously substantially from the container wall to the center of the burner can be utilized.

FIGURE 7 shows a burner provided with means for supplying atmospheric air to the center of the flame to increase the combustion rate, provide more complete combustion and reduce smoke formation. The combustible container 42 is provided with a plurality of combustible tubes 44 extending vertically upward from corresponding openings at the base of the container. The container is provided with leg means 46 to elevate it and permit access of atmospheric air to the bottom of tubes 44. As indicated by wax level 48, molten wax fills the space in container 42 not occupied by vertical tubes 44. Since tubes 44 are dispersed throughout the cross-section of the burner they serve as an igniter material and no other igniter material is required. As shown in FIGURE 7, the tops of tubes 44 extend above wax level 48.

Various changes and modifications can be made without departing from the spirit of this invention or the scope thereof as defined in the following claims.

We claim:

1. A burner comprising a combustible container containing wax and having an igniter material dispersed substantially uniformly within the wax and protruding above the surface of the wax at a plurality of points in sufficient quantity so that upon ignition thereof substantially the entire upper surface of said wax is raised to its kindling temperature.

2. The burner of claim 1 including a gelling agent in said wax.

3. The burner of claim 2 wherein said gelling agent is selected from the group consisting of 12-hydroxy stearic acid and aluminum stearate.

4. The burner of claim 1 including a combustion improver additive in said wax.

5. The burner of claim 1 including a smoke depressant in said wax.

6. The burner of claim 5 wherein said smoke depressant is present in a concentration not greater than 0.1 percent by weight based upon said wax.

7. The burner of claim 5 wherein said smoke depressant is dicyclopentadienyl iron.

8. A burner comprising a combustible container containing wax and having an igniter material dispersed substantially uniformly throughout the cross-section of the wax in the upper region thereof and protruding above the surface of the wax at a plurality of points in sufficient quantity so that upon ignition thereof substantially the entire upper surface area of said wax is raised to its kindling temperature.

9. The burner of claim 8 wherein said igniter material is excelsior.

10. The burner of claim 8 wherein said igniter material is straw.

11. The burner of claim 8 wherein said container is tapered so that its cross section increases with height.

12. The burner of claim 8 wherein said container is tapered so that its cross section decreases with height.

13. A burner comprising a combustible container filled with wax and having a substantially continuous igniter material in the configuration of a spiral extending through said wax substantially between the container wall and the center of the burner, said igniter material protruding above the surface of said wax so that upon ignition thereof substantially the entire upper surface area of said wax is raised to its kindling temperature.

14. The burner of claim 13 wherein said igniter material is an extension of said container.

15. A burner comprising a combustible container filled with wax provided with combustible tube means for supplying atmospheric air upwardly through said wax, said tube means extending above the level of said wax, and said tube means constituting an igniter material for said burner.

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