(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 978 686 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
07.04.2004 Bulletin 2004/15

(21) Application number: **99900677.8**

(22) Date of filing: **26.01.1999**

(51) Int Cl.[7]: **F23D 3/08**, F23D 3/40, F23Q 2/44

(86) International application number:
PCT/JP1999/000298

(87) International publication number:
WO 1999/037953 (29.07.1999 Gazette 1999/30)

(54) **COMBUSTION WICK OF LIQUID FUEL COMBUSTOR**

DOCHT FÜR EINE MIT FLÜSSIGEM BRENNSTOFF BETRIEBENE VERBRENNUNGSVORRICHTUNG

MECHE DE COMBUSTION D'UNE CHAMBRE DE COMBUSTION DE COMBUSTIBLE LIQUIDE

(84) Designated Contracting States:
DE DK ES FR GB IT NL SE

(30) Priority: **26.01.1998 JP 1262098**
19.03.1998 JP 7024798

(43) Date of publication of application:
09.02.2000 Bulletin 2000/06

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(56) References cited:
DE-A- 4 327 437
JP-A- 3 247 915
JP-A- 55 053 604
JP-A- 57 062 309
JP-A- 57 115 606
JP-A- 61 038 315
JP-U- 4 073 703
JP-Y1- 36 013 262
JP-Y1- 38 009 171
US-A- 4 569 656

- **PATENT ABSTRACTS OF JAPAN vol. 004, no. 116 (M-027), 19 August 1980 (1980-08-19) & JP 55 075106 A (MATSUSHITA ELECTRIC IND CO LTD), 6 June 1980 (1980-06-06)**

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Description

Filed of the Invention

[0001] This invention relates to a wick that, in a cigarette lighter, fire-lighting device or other burner using a liquid fuel composed mainly of alcohol, utilizes capillary attraction to draw up from a fuel tank liquid fuel to be burned, particularly to the structure of the flame-producing section where combustion is conducted.

Background of the Invention

[0002] An alcohol fuel such as ethyl alcohol, a benzine fuel of the petroleum benzin type including gasoline or a liquid gas fuel such as butane gas or propane gas is generally used as the fuel of a cigarette lighter, fire-lighting device, torch, lamp or other such burner.

[0003] The performance, ease of use, and structural design of such burners differs depending on the kind of fuel used, and each has its own characteristics.

[0004] In the case of a benzine fuel that is a mixture of petroleum benzin-type hydrocarbon compounds, for example, the fuel is a mixture of compounds with different boiling points. During initial use after the burner is lit, volatilization of the components begins with the low-boiling-point benzine components and then progressively shifts to hydrocarbons with higher boiling points. Since the composition of the fuel remaining in the burner therefore varies over the burning period, the flame length changes. The same is true of gasoline. As benzine and gasoline have high volatility, burners that use them require a sealed structure for reducing evaporation from the fuel storage section and the wick portion. If the sealing is insufficient, fuel is lost through evaporation and the frequency of bothersome fuel refills increases. In addition, benzine and gasoline have distinctive odors which may be found disagreeable.

[0005] In the case of a liquid gas fuel, the gas pressure is high in the use temperature range of the burner and the vessel storing the fuel has to have a pressure-resistant structure. Moreover, the flame length changes with variation in the gas pressure and since it is a characteristic of the gas pressure to vary logarithmically and greatly with temperature, large change in flame length with temperature becomes a particular problem. In order to reduce this flame-length variation, the fuel supply system of the burner requires a special design countermeasure for effecting temperature compensation, which complicates the structure and is disadvantageous from the aspect of cost.

[0006] As regards an alcohol fuel, on the other hand, a liquid fuel composed mainly of alcohol, e.g., a lower monovalent alcohol such as ethyl alcohol, methyl alcohol or propyl alcohol, is a liquid at ordinary temperatures and is also relatively low in vapor pressure. The fuel storage section therefore does not require a pressure-resistant vessel and the sealing structure for sealing the fuel tank and the wick need only be capable of preventing alcohol evaporation. This is advantageous from the point of simplifying the structure and lowering the cost of the burner.

[0007] Further, in the burner using a liquid fuel composed mainly of alcohol, the means used to supply the liquid fuel from the fuel storage section to the flame-producing section is generally a wick that utilizes the surface tension of the liquid fuel to draw it up through continuous fine holes or fine voids among bundled thin fibers by capillarity and burns it at the tip portion thereof.

[0008] Specifically, the wick used for drawing up the fuel is a string-like one obtained by twisting fibers, one obtained by bundling glass fibers, one using both of these with the glass fibers enclosed in cotton yarn and the result wound with fine metal wires to prevent disintegration, or the like, whose lower draw-up section functions to draw up fuel to be burned at the upper flame-producing section.

[0009] In the cigarette lighter, fire-lighting device or other such burner using a wick of the foregoing type, moreover, the initial flame length after lighting, the change in flame length, the saturated flame length, the flame thickness and the like differ depending on the material and shape of the wick. The burner must therefore be configured to satisfy the desired characteristics for the use mode.

[0010] In other words, when a cigarette lighter or a fire-lighting device is fabricated using one of the foregoing conventional wicks and the flame-producing section at the tip is lit, a flame is formed by burning of gas produced by liquid fuel volatilizing from the tip end surface and the tip peripheral portion of the flame-producing section. When liquid fuel further volatizes and rises from the lower peripheral portion of the flame-producing section and is then lit, a still thicker and longer flame is formed. This burning condition is similar to the shape of a flame produced by lighting a candle. In contemplating a wick for obtaining the required flame length, taking continuous combustion into consideration, it is necessary to give the wick a certain degree of thickness, i.e., largeness of the tip end surface. However, a proportional relationship exits between the thickness of the wick and the thickness of the flame, so that the flame is thicker with a thicker wick.

[0011] Moreover, when the burner is, for example, a cigarette lighter, since a flame of thinner thickness is easier to use for the purpose of lighting a cigarette, it is desirable to maintain the flame length while simultaneously keeping the flame thickness small. Contradictory needs thus arise.

[0012] Further, in order to light a wick of the foregoing type, it is necessary for volatized liquid fuel to be present in the vicinity of the portion of the wick acted on by sparks produced by a flint or electric discharge. It has been found that, in addition to the volatization of fuel from the upper end surface of the wick, it is also important from the aspect of securing igniting performance that fuel volatized from the wick side surface also be present, particularly that it greatly affects the lighting success rate at low temperatures.

[0013] In designing the burner, moreover, although the igniting performance is better when the igniter for causing sparks to fly toward the wick is installed closer to the wick, when the flame is thick, the edge of the flame comes close to the igniter to raise the temperature of the igniter (e.g., a striker wheel). If the striker wheel should be heated, the heat may, for example, be conducted to its plastic support portion to melt the support portion. The striker wheel may then be detached by the pressing force of the flint urged against the striker wheel, making it useless. In particular, when the wick and the igniter are near each other, the flow of air around the wick changes and the flame tends to swell toward the igniter side. This may cause the aforesaid problem of overheating.

[0014] On the other hand, in a burner using a liquid fuel composed mainly of alcohol, the flame may be hard to see even if a material exhibiting a flame coloring reaction is added to the fuel. A need is therefore also felt for further coloring the flame to increase the clarity of the flame shape.

[0015] JP 55 075106 A shows a gasification wick comprising an exterior tar-permeation preventing material between a gasification portion thereof and a fuel-wetted portion thereof, whereby the permeation of tar into an inner portion of the gasification wick and a decrease in the fuel sucking performance thereof can be prevented. Furthermore, at least a side surface not including an upper end surface of the flame-producing section of the wick is provided with a skin layer for suppressing volatization of liquid fuel.

[0016] DE 43 27 437 A discloses a wick for a liquid fuel burner wherein a thin metal ring is placed around the top end of the wick, thereby suppressing fuel volatization through the side surface of the wick.

[0017] In view of the foregoing circumstances, the present invention is aimed at providing a wick for a liquid fuel burner that makes it possible to obtain a flame shape suitable to the purpose of use, particularly a thin and long flame.

Disclosure of the Invention

[0018] The invention liquid fuel burner wick, which overcomes the problems set out in the foregoing, has liquid fuel impregnated in stuffing accommodated in a fuel tank and comprising a wick with a draw-up section in contact with the stuffing for drawing up liquid fuel by capillarity and burning it at a tip flame-producing section and an igniter for lighting the flame-producing section, the wick is constituted of a porous material and at least a side surface not including an upper end surface of the flame-producing section is provided with a skin layer for suppressing volatization of liquid fuel, wherein the wick liquid fuel volatization suppressing action at a side surface on the side of the igniter is smaller than volatization suppressing action at other side surface.

[0019] The liquid fuel volatization suppressing action of the side surface on the side of the igniter can be made smaller than that of other side surfaces by slit-wise removing the skin layer to form it partially or by not forming the skin layer. In the case of these, the skin layer can be formed of a material having no permeability whatsoever with respect to the liquid fuel.

[0020] As regards providing the skin layer throughout or partially on the wick side surfaces, it is preferable to provide the skin layer as a porous coating having lower liquid fuel permeability than the permeability at the wick interior so as to enable liquid fuel to permeate to and volatize from the surface.

[0021] The skin layer is constituted, for example, by application of or immersion in what is obtained by mixing a metal oxide powder and a binder, and solidification by drying. Otherwise the skin layer is constituted by application of or immersion in what is obtained by mixing a heat-resistant inorganic compound powder, a metal powder or a mixture thereof and a binder, and solidification by drying. As the metal oxide powder is used titanium oxide, aluminum oxide or the like, individually or as mixed. As the binder it is preferable to use a waterglass material such as sodium silicate or potassium silicate or a low-melting-point glass material. The skin layer is preferably provided to a thickness of 0.2mm-0.5mm.

[0022] The skin layer can be constituted by application of or immersion in a heat-resistant paint, and drying. The skin layer preferably contains a metal compound exhibiting a flame coloring reaction. On the other hand, the skin layer can be added with carbon. After the skin layer has been formed, it can be applied with a coating solution containing carbon.

[0023] The liquid fuel permeability of the skin layer can be made to differ between the upper end and other portions of the flame-producing section. For example, it can be provided so that its permeability is high at the upper end and low at the lower end, or vice versa. In this case, it suffices to provide the skin layer to differ in thickness between the upper end and other portions of the flame-producing section.

[0024] The tip end surface of the wick provided with the skin layer can be formed as an inclined surface and the inclined surface be disposed to face the igniter.

[0025] The wick is preferably formed of a heat-resistant material such as ceramic fiber or glass fiber to have a bar-like shape of rectangular cross-section, but can also be formed of a porous ceramic or porous glass material. Moreover, the wick can also be constituted of a porous material compression-formed in a direction perpendicular to the axial direction thereof. A surface compressed during compression-forming can be disposed to face the igniter for the purpose of preventing overheating of the igniter in the case where the formation of the skin layer makes the overall amount of volatization from the side surfaces large. Or a surface perpendicular to a surface compressed during compression-forming can be disposed to face the igniter so as to enhance the lighting success rate in the case where the formation of the skin layer makes the overall amount of volatization from the side surfaces small.

[0026] In the case of the aforesaid wick for a liquid fuel burner according to the present invention, the length of the flame is maintained while simultaneously reducing its thickness because the volatization of liquid fuel from the side surfaces of the flame-producing section is, by formation of the skin layer, controlled to be suppressed to a degree enabling ignition. In other words, in the case of a wick having the sides of its flame-producing section completely covered and sealed by a skin layer with no permeability with respect to the liquid fuel, i.e., one with absolutely no volatization of fuel from its side surfaces, the liquid fuel produces a flame only by the fuel volatization from the upper end surface of the wick and the flame is therefore narrow. However, since a wick is usually lit from a side surface, lighting becomes difficult in the case of a wick that produces no liquid fuel volatization at such a side surface.

[0027] Regarding this point, in the case of the present invention, the wick enables lighting from a side surface by scattering sparks and, moreover, so as not to make the flame thickness large, is either formed with a porous skin layer that permits permeation and volatization of liquid fuel from the side surfaces of the flame-producing section of the wick to a degree enabling ignition or is made so that the volatization suppressing action of the side surface on the side of the igniter is smaller than that of the other side surfaces, thereby enabling good ignition by the igniter, while drawing up liquid fuel to the upper end surface of the wick and exposing it at a surface of the wick material having high volatization performance, thereby producing a long and thin flame and enabling ordinary lighting.

[0028] As the liquid fuel composed mainly of alcohol, there can, for example, be used one having a lower monovalent alcohol, namely, methyl alcohol, ethyl alcohol or propyl alcohol, as its main component and having mixed therewith a saturated hydrocarbon such as hexane or heptane for coloring the flame.

[0029] With a wick for a liquid fuel burner such as the foregoing, by constituting the wick of a porous material and providing the skin layer to suppress volatization of liquid fuel from the wick side surfaces on at least a wick side surface not including the upper end surface, good igniting performance can be secured from the igniter side owing to the fuel volatized from the side surface on the side of the igniter. Moreover, the upper end surface of the wick can be given some degree of magnitude so that the desired flame length is ensured by sufficient fuel volatization from the upper end surface, while the skin layer, by suppressing the amount of fuel volatization from the side surfaces, enables the thickness of the flame, particularly the thickness of its lower end, to be prevented from enlarging, so as to keep the flame thin and prevent temperature rise of the igniter caused by the flame approaching the igniter, and a flame of a thin and long shape not obtainable in the past can be obtained with a simple structure. As this increases the degree of freedom regarding flame shape, it becomes possible to secure characteristics matched to the purpose of use of, for example, a cigarette lighter, fire-lighting device or other such burner, and thereby increase its commercial value.

[0030] In the case of the wick that is provided with the skin layer and has the volatization suppressing action of the side surface on the side of the igniter made smaller than that of the other side surfaces, the objective of making it easy to secure a volatization amount for lighting and the objective of thinning the flame thickness by suppressing volatization at the other side surfaces can both be readily achieved at the same time.

[0031] Moreover, forming a skin layer such as described in the foregoing heightens the hardness of the flame-producing section of the wick, thereby increasing its strength, and prolongs the service life of the flame-producing section with respect to use.

[0032] Further, the time-course change in the flame during continuous burning after lighting is such that the growth in the flame length immediately after lighting rises rapidly and the saturated flame length is short, so that burning characteristics ideal for a fire-lighting device or the like are obtained.

[0033] In addition, the flame is formed mainly by burning fuel volatized from the upper end surface of the flame-producing section of the wick and is not dependent on the amount of volatization from the side surfaces of the flame-producing section. The amount of projection of the flame-producing section of the wick from the wick holder can therefore by shortened, which makes it easer to design a closure cap for covering the flame-producing section to prevent volatization.

[0034] As the volatization of fuel from the side surfaces of a flame-producing section of the foregoing description is controlled by forming the skin layer so as to form a thin and long flame, fuel consumption is reduced in comparison with burning that produces a thick flame of the same length and, therefore, the number of uses and the use time are greatly increased for the same amount of fuel.

[0035] On the other hand, in the case of a burner that preferably enables the shape of the flame to be visible during burning, inclusion of sodium or other such flame coloring component in the skin layer causes coloring of the flame

owing to a flame coloring reaction produced by the flame coloring component in the skin layer during burning, whereby the shape of the flame can be made more discernible. Similarly, when carbon is included in the skin layer or when the skin layer is given a coat containing carbon, the carbon is freed as the burning proceeds to color the flame yellow and make it easier to see.

BRIEF DESCRIPTION OF DRAWINGS

[0036]

Figure 1A is an explanatory view showing the burning condition with a wick having the basic structure according of the present invention.
Figure 1B is an explanatory view showing the burning condition of a wick that is a comparative example.
Figure 2 is an explanatory view showing the burning condition when the permeability of a skin layer of the wick of the invention is lower.
Figure 3 is a schematic sectional view of a cigarette lighter as an example of a liquid fuel burner incorporating a wick that is an embodiment of the invention.
Figure 4 is a schematic sectional view of a cigarette lighter as an example of a liquid fuel burner incorporating a wick that is another embodiment of the invention.
Figure 5 is a schematic plan view of a cigarette lighter as an example of a liquid fuel burner incorporating a wick that is still another embodiment.
Figure 6 is a perspective view of a tip portion of a wick that is another embodiment.
Figure 7 is a sectional view showing the structure of a burner used in tests.
Figure 8 is a graph showing flame length change properties in Test 1 and Test 2, together with a comparative example.
Figure 9 a graph showing flame length change property in Test 3, together with a comparative example.
Figure 10 is a graph showing flame length change property relative to flame-producing section projection length in Test 4.
Figure 11 is graph showing relationship between flame-producing section projection length and saturated flame length in Test 4.
Figure 12 is a graph showing relationship between skin layer thickness and different flame lengths in Test 6.
Figure 13 is a graph showing relationship between skin layer thickness and flame thickness in Test 6.
Figure 14A is a diagram showing igniting performance in the condition where the skin layer of a compressed surface of the wick of Figure 7 was formed with a 0mm-wide slit and disposed to face an igniter.
Figure 14B is a diagram showing igniting performance in the condition where the skin layer of a compressed surface of the wick of Figure 7 was formed with a 0.5mm-wide slit and disposed to face the igniter.
Figure 14C is a diagram showing igniting performance in the condition where the skin layer of a compressed surface of the wick of Figure 7 was formed with a 1.0mm-wide slit and disposed to face the igniter.
Figure 14D is a diagram showing igniting performance in the condition where the skin layer of a compressed surface of the wick of Figure 7 was formed with a 2.0mm-wide slit and disposed to face the igniter.
Figure 14E is a diagram showing igniting performance in the condition where the skin layer of a compressed surface of the wick of Figure 7 was formed with a 3.0mm-wide slit and disposed to face the igniter.
Figure 15A is a diagram showing igniting performance in the condition where the skin layer of a cut surface of the wick of Figure 7 was formed with a 0mm-wide slit and disposed to face the igniter.
Figure 15B is a diagram showing igniting performance in the condition where the skin layer of a cut surface of the wick of Figure 7 was formed with a 0.5mm-wide slit and disposed to face the igniter.
Figure 15C is a diagram showing igniting performance in the condition where the skin layer of a cut surface of the wick of Figure 7 was formed with a 1.0mm-wide slit and disposed to face the igniter.
Figure 15D is a diagram showing igniting performance in the condition where the skin layer of a cut surface of the wick of Figure 7 was formed with a 2.0mm-wide slit and disposed to face the igniter.
Figure 15E is a diagram showing igniting performance in the condition where the skin layer of a cut surface of the wick of Figure 7 was formed with a 3.0mm-wide slit and disposed to face the igniter.

BEST MODE FOR CARRYING OUT THE INVENTION

[0037] Embodiments of the wick for a liquid fuel burner according to the invention will be explained in the following with reference to the drawings.

[0038] First, Figure 1A shows the basic structure of the wick of the present invention. The main body of the wick 6 is formed of a porous material. The portion projecting upward from a wick holder 7 is formed as flame-producing section

61 and a portion below the wick holder 7 that makes contact with stuffing 3 (see Figure 3) impregnated with and retaining liquid fuel is formed as a draw-up section 62.

[0039] Part or all of the side surfaces of the flame-producing section 61 of the wick 6, not including an upper end surface 6a, is provided with a skin layer 8 for suppressing volatization of liquid fuel from the side surfaces. The skin layer 8 is, for example, formed porous so as to have permeability enabling liquid fuel drawn up through the wick interior by capillarity to pass to the surface and volatize and so that the permeability thereof is lower than the permeability of the main body material at the wick interior.

[0040] Specifically, as explained in detail later with reference to the embodiments, the wick 6 is formed in, for instance, bar shape of a porous material having internal capillary passages, such as ceramic fiber, acrylic fiber, glass fiber, porous ceramic or porous glass material and the outer periphery from the flame-producing section 61 thereof to the portion retained by the wick holder 7 is formed with the skin layer 8 to a thickness of 0.2-0.5mm by application of or immersion in, and drying, of a heat-resistant paint or a coating solution obtained by mixing a metal oxide powder such as of titanium oxide or aluminum oxide, a heat-resistant inorganic compound powder, a metal powder or the like with a binder composed of a waterglass material such as sodium silicate or potassium silicate or a low-melting-point glass material.

[0041] The upper end surface 6a of the flame-producing section 61 is not applied with the coating solution or the tip end surface thereof is cut off after coating, so as to expose the wick material surface of the aforesaid ceramic fiber or the like. The relationship between the igniting performance and the flame thickness can be adjusted by adjusting the coating thickness of the coating solution. The upper end surface 6a can be formed to be inclined.

[0042] Figure 1B shows the burning condition of a wick 60 that is a comparative example not formed with a skin layer. As the permeability of the outer peripheral surfaces of the flame-producing section 61 is high, a large amount of fuel is volatilized as indicated by the arrows. The flame formed by lighting and burning of this fuel volatized at the side surfaces joins with the flame produced by the volatized gas from the upper end surface 6a to form a thick and large flame overall. The flame is particularly thick at the lower end. In addition, the temperature rise caused by continuous burning after lighting increases the amount of volatization from the upper end surface 6a and the peripheral surfaces, so that the flame enlarges to assume a saturated state like that illustrated.

[0043] In contrast, as regards the burning condition at the invention wick 6 shown in Figure 1A, fuel volatizes from the upper end surface 6a in the foregoing manner but volatization of fuel from the peripheral surfaces of the flame-producing section 61 is suppressed and reduced owing to the formation of the skin layer 8. The flame produced by lighting the volatized gas from these side surfaces is therefore small and the lower end of the overall flame is thin. Although the flame length is somewhat shortened, a sufficient length is obtained. Moreover, even if the amount of volatization increases owing to temperature rise after lighting, increase in the amount of volatization from the peripheral surfaces is suppressed, whereby growth of the saturated flame length is suppressed. Further, since the flame is formed mainly by fuel volatized from the upper end surface 6a of the flame-producing section 61 of the wick 6, the projection length of the flame-producing section 61 from the wick holder 7 can be about 3mm, which is shorter than one not formed with the skin layer.

[0044] Figure 2 shows the burning when the skin layer 8 is formed thick to further lower the fuel permeability of the side surfaces of the flame-producing section 61. When the volatization by permeation through the skin layer 8 is low, the temperature rise occurring simultaneously with flame formation after lighting of the flame-producing section 61 generates an updraft at the side surfaces of the flame-producing section 61. The fuel gas volatized from the skin layer 8 therefore rises without forming a flame at the side surfaces and burns after merging with the flame produced by the fuel gas volatized from the upper end surface 6a of the flame-producing section 61. In this case, the thickness of the lower end of the flame becomes still thinner. Thus the thickness and length of the flame can be determined to match the purpose of use of the burner. In order to enhance the lighting success rate in such case, the skin layer 8 can be partially or totally removed on the side surface on the ignition side so as to reduce the volatization suppressing action and increase the amount of volatization for lighting.

[0045] In addition, the flame shape can be further varied by making the permeability of the skin layer 8 high at the upper end and low at the lower portion, or vice versa, such as by making the coating thickness different.

[0046] While the amount of volatization by permeation through the skin layer 8 must be an amount sufficient to ensure igniting performance, the required amount varies with, for example, the igniting performance of the igniter.

[0047] In order to make the shape of the flame easier to see, a metal compound exhibiting a flame coloring reaction or carbon is added to the skin layer 8 or the skin layer 8 is coated with a paint mixed with carbon.

<First Embodiment>

[0048] Figure 3 shows a schematic sectional view of the structure of a cigarette lighter as an example of a liquid fuel burner incorporating a wick 6 of the foregoing type. It also shows a specific example of the wick 6.

[0049] A lighter 1 has a fuel tank 2 of cylindrical shape with closed bottom. Stuffing 3 composed of a fiber material is inserted into the interior of the fuel tank 2 to be impregnated with and retain liquid fuel. A top cover 4 is fixed to the

upper portion of the fuel tank 2 to constitute a fuel reservoir section 5 for storing liquid fuel. The stuffing 3 is charged into the fuel tank 2 from the bottom side to leave an upper space 2a.

[0050] The fuel tank 2 is, for example, provided as a shaped article made of polypropylene with an inner volume of 5cm^3. The stuffing 3 is polypropylene fiber of a thickness of 6 denier compacted in the fuel tank 2 to a density of 0.05g/cm^3. 4g of liquid fuel, a mixture of 95wt% ethyl alcohol and 5wt% n-hexane, is poured and impregnated into this stuffing 3 for storage therein.

[0051] A metal wick holder 7 is fixed to the top cover 4 as passed vertically therethrough into the fuel tank 2. The bar-shaped wick 6 is inserted vertically into the wick holder 7. The wick 6 is formed integrally of the same material at the flame-producing section 61, i.e., the tip end projecting upward from the wick holder 7, and at a lower draw-up section 62 in contact with the stuffing 3.

[0052] The wick 6 is formed of ceramic fiber by, for example, adding a small amount of organic binder and curing agent to 2.8μm-thick ceramic fibers obtained by fiberizing a raw material composed mainly of alumina and silica, forming the fibers into a plate having a fiber packing density of 0.16g/cm^3, cutting a 70mm-long bar of 3mmx4mm rectangular cross-section from the plate and inserting the bar in the wick holder 7 of an inner diameter of 5.0mmϕ, an outer diameter of 6.0mmϕ and a length of 7.0mm. The flame-producing section 61 of the wick 6 is fixed so that its projection length from the upper end surface of the wick holder 7 is 3mm and that its draw-up section 62 is inserted into the stuffing 3 to a length of 45mm from the lower end.

[0053] At least the side surfaces of the flame-producing section 61 of the wick 6 are covered by a skin layer 8 that is porous and has a lower liquid fuel permeability than the internal material. The skin layer 8 is formed on the side surfaces to a prescribed length (e.g., 10mm) from the upper end of the wick 6, with the ceramic fiber surfaces of the upper end surface 6a and the side surfaces of the draw-up section 62 being left exposed.

[0054] The skin layer 8 in the present embodiment is formed by preparing a coating solution obtained by mixing 50wt% of sodium silicate + 50wt% of water and mixing the result with titanium dioxide at a mixing ratio of 70wt% to 30wt%, applying this coating solution to a thickness after drying of 0.3mm, and then drying it.

[0055] Such a wick 6 draws up the liquid fuel impregnated in the stuffing 3 by its draw-up section 62 utilizing capillarity. The drawn-up liquid fuel is supplied to the flame-producing section 61 and the flame-producing section 61 projecting upward from the wick holder 7 is lit to burn and generate a flame.

[0056] The wick 6 can have its flame-producing section 61 and its fuel draw-up section 62 formed of different materials. In this case, the flame-producing section 61 is formed of the aforesaid ceramic fiber and the draw-up section 62 is formed of, for example, acrylic fiber and the two are joined in contact. This draw-up section 62 is formed by adding a binder and a curing agent to acrylic fibers of a fiber thickness of 3 denier and bundling them into a rod to have a void ratio after bonding and shaping of 60% and an outer diameter of 3.4mmϕ.

[0057] An igniter 10 is installed on the top cover 4 to face the tip of the flame-producing section 61. A bracket 11 of the igniter 10 fixed to the top cover 4 has a flint 12 inserted therein to be vertically movable and a rotating striker wheel 13 is provided on an upper cover of the bracket 11. The tip of the flint 12 is pressed onto the peripheral surface of the rotating striker wheel 13 by the energizing force of a flint pusher spring 14 and rotation of the rotating striker wheel 13 causes sparks to fly toward the wick 6.

[0058] A closure cap 16 for evaporation prevention is provided to openably/closably cover the flame-producing section 61 together with the protruding portion of the wick holder 7. This closure cap 16 is rotatably pivoted by a pin 17 at one end portion of the upper surface of the top cover 4 of the fuel tank 2. At the inner surface of the closure cap 16 is provided an inner cover 16a for enclosing the outer periphery of the wick holder 7 and covering/sealing the tip of the flame-producing section 61. An O-ring 19 is horizontally attached to the outer peripheral root portion of the wick holder 7 and the inner peripheral surface of the inner cover 16a presses thereon to enhance the sealing property. A face plate 18 is provided on the upper surface of the top cover 4.

[0059] The gaps formed between the round inner surface of the wick holder 7 and the peripheral surfaces of the flame-producing section 61 of rectangular cross-section function as air passages that communicate the interior of the fuel tank 2 with the upper space 2a.

[0060] The cigarette lighter 1 of Figure 3 was used and the change in flame length during continuous burning after lighting was measured. The flame length immediately after lighting was 18mm, grew quickly to 35mm at 5 seconds, and then assumed a saturated state of equilibrium with a flame length of 38mm at 10 seconds (see Test 1 in Figure 8). The maximum thickness of the flame was 7mm. The flame in the burning condition after passage of a certain time period following lighting exhibited orange coloration owing to a flame coloring reaction of the sodium silicate in the skin layer 8. There was thus obtained a thin and long flame shape satisfying the burning conditions required of a cigarette lighter.

[0061] A similar skin layer could also be formed when aluminum oxide powder (alumina powder) was incorporated instead of the titanium dioxide. A similar skin layer could also be formed when potassium silicate was incorporated instead of the sodium silicate.

<Second Embodiment>

[0062] A different material is used to form the skin layer 8 in this embodiment. Namely, low-melting-point glass (glass frit) is used as the binder (bonding agent). In other aspects it is formed like that of the first embodiment.

[0063] The skin layer 8 of this embodiment is formed by preparing a coating solution obtained by mixing 80wt% of glass frit and 20wt% of titanium dioxide and mixing the result at a mixing ratio of 1 : 1 with a 5% solution of polyvinyl alcohol as binder, applying this coating solution to the outer periphery of the flame-producing section 61 of the wick 6 over a length of the side surfaces of 10mm from the upper end surface (thickness: 0.3mm) and, after drying, sintering it at 800°C x 10min (temperature increase rate: 10°C/min). The composition of the glass frit of the foregoing example is SiO_2 : 10%, ZnO : 65% and B_2O_3 : 25%.

[0064] The lighter of this embodiment was used and the change in flame length after lighting was measured. The flame length immediately after lighting was 20mm and then grew to 40mm at 5 seconds, in which condition it assumed a saturated state of equilibrium. The maximum thickness of the flame was 7mm. A thin and long flame shape like that of the first embodiment was obtained.

<Third Embodiment>

[0065] In this embodiment, the surface of the skin layer 8 of a wick 6 formed in the same manner as that of the first embodiment is further formed with a coating layer.

[0066] Specifically, the skin layer 8 is constituted by applying and drying a coat of an oil ink containing carbon on a coated surface applied with a coating solution obtained by mixing 70wt% of a mixture of 50wt% of sodium silicate + 50wt% of water with 30wt% of titanium dioxide.

[0067] The lighter was used and the change in flame length after lighting was measured. The results obtained for the change in flame length and flame thickness after lighting were the same as in the first embodiment. Moreover, owing to the formation of the coating layer containing carbon, a further orange coloration of the flame was exhibited because of the flame coloring effect of the carbon.

<Fourth Embodiment>

[0068] As shown in Figure 4, in this embodiment the upper end surface 6a of the wick 6 provided with the skin layer 8 is formed as an inclined surface and the inclined upper end surface 6a is disposed to face the igniter 10.

[0069] Since the inclined upper end surface 6a of the wick 6 faces the sparks scattered by rotation of the rotating striker wheel 13, the upper end surface 6a readily receives the sparks, thereby improving the igniting performance. This is an effective structure for improving igniting performance when fuel volatization from the side surfaces provided with the skin layer 8 is small owing to the type or thickness of the skin layer 8.

<Fifth Embodiment>

[0070] This embodiment, in which the wick 6 is similar to that of the first embodiment, relates to the porous material at the interior of the wick 6, namely, the material density of some of the surfaces is high. The wick 6 is formed of ceramic fiber of the type mentioned earlier, this ceramic fiber is added with a small amount of organic binder and curing agent and compressed into a plate, which is cut to form a 70mm-long bar of 3mmx4mm rectangular cross-section, and a skin layer 8 is similarly formed on the side surfaces of the flame-producing section 61.

[0071] The wick 6 fabricated in the foregoing manner is compression-formed in a direction perpendicular to its axial direction (longitudinal direction). The compressed surfaces (surfaces that received pressing force during the compression) have higher material density and exhibit a property of lower liquid fuel permeability than the interior.

[0072] When the suppression of liquid fuel volatization from the side surfaces of the wick 6 produced by the skin layer 8 is small, a compressed surface of the wick 6 is disposed to face the igniter 10 and the cut surfaces are made to face sideways. With this orientation, since the fuel volatization of a compressed surface of the wick 6 is smaller than that of a cut surface, the swelling of the flame at the portion facing the igniter 10 is smaller than when a cut surface faces it. Although the overall flame is not so thin, contact of the flame with the igniter 10 can be suppressed to prevent its overheating.

[0073] When the suppression of liquid fuel volatization from the side surfaces of the wick 6 produced by the skin layer 8 is large, a cut surface lying perpendicular to the compressed surfaces of the wick 6 is disposed to face the igniter 10 and the compressed surfaces are made to face sideways. With this orientation, since more fuel is volatized from a cut surface of the wick 6 than from a compressed surface, the amount of liquid fuel volatized from the portion facing the igniter 10 increases to improve the lighting success rate by the igniter 10 and the flame can be made thin overall. The relationship between the compressed surface orientation and the lighting success rate is shown in Test 7

set out later.

<Sixth Embodiment>

[0074] In this embodiment, the liquid fuel volatization suppressing action at a side surface 6b on the igniter 10 side of the wick 6 formed with the skin layer 8 is made smaller than the volatization suppressing action of the other side surfaces.

[0075] Figure 5 is a plan view showing a lighter 1 equipped with the wick 6 of this embodiment, with the closure cap 16 removed. The wick 6 is made of ceramic fiber, has a 3mmx4mm rectangular cross-section, is 70mm in length, and has its three side surfaces other than the side surface 6b on the side of the igniter 10 formed with the skin layer 8 over a length of 10mm from the upper end surface 6a thereof. The skin layer 8 is constituted by applying and drying a coating solution obtained by mixing sodium silicate and titanium dioxide at a mixing ratio of 70wt% to 30wt%, to a thickness of 0.3mm, and not applying the skin layer 8 to the upper end surface 6a of the wick 6 and the side surface 6b thereof on the side of the igniter 10 but leaving the internal material exposed. The wick 6 is inserted into and fixed in the wick holder 7 so that the projection length is 3mm. Other aspects are like those of the first embodiment.

[0076] The thickness of the flame in the burning condition of the lighter 1 of this embodiment was somewhat swollen toward the side of the igniter but a flame that was of thin and long shape overall was obtained because the skin layer 8 suppressed volatization from the side surfaces. The igniting performance was good because the amount of volatization from the side surface 6b on the igniter 10 side was large. As in Test 7 discussed later, a lighting test was conducted for different locations of the wick 6 relative to the igniter 10. Excellent lighting success rates were obtained within the range of distances between the center line of the rotating striker wheel 13 and the center line of the wick 6 of 7 to 12mm and positions of the upper end surface of the flint 12 above the upper end surface 6a of the wick 6 of -1 to 6mm.

<Seventh Embodiment>

[0077] In this embodiment, the liquid fuel volatization suppressing action at the side surface 6b on the igniter 10 side of the wick 6 formed with the skin layer 8 is made smaller than the volatization suppressing action of the other side surfaces.

[0078] The external configuration of only the tip portion of the wick 6 is shown Figure 6. The skin layer 8, which is of the same composition as that of the preceding embodiment, is provided with respect to the wick 6, which is constituted like that of sixth embodiment, to completely surround it over a range of 10mm from the upper end of the flame-producing section 61 and, further, the middle portion of the skin layer 8 at the side surface 6b of the flame-producing section 61 on the igniter 10 side is formed with a slit 8a by removing a prescribed width (0.5-2mm) thereof in the vertical direction, thereby exposing the wick material so as to make the liquid fuel volatization suppressing action of the side surface 6b on the igniter 10 side smaller than the volatization suppressing action of the other side surfaces.

[0079] The thickness of the flame in the ignited condition of the lighter incorporating the wick 6 of this embodiment was somewhat swollen toward the side of the igniter, depending on the size of the slit width, but a flame that was of thin and long shape overall was obtained because the skin layer 8 suppressed volatization from the side surfaces. The igniting performance was good because the amount of volatization from the side surface 6b on the igniter 10 side was increased. As in Test 7 discussed later, a lighting test was conducted for different locations of the wick 6 relative to the igniter 10. When the slit width was 1mm, excellent lighting success rates were obtained within the range of distances between the center line of the rotating striker wheel 13 and the center line of the wick 6 of 8 to 12mm and positions of the upper end surface of the flint 12 above the upper end surface 6a of the wick 6 of -1 to 6mm.

<Eight Embodiment>

[0080] The material of the wick 6 is different in this embodiment, namely, one formed as a round rod by extrusion of acrylic fiber added with a binder is used. The tip portion thereof is defined as the flame-producing section 61 and a skin layer 8 like that of the first to third embodiments is formed on the outer periphery thereof.

[0081] The wick 6 composed of acrylic fiber is of a material with high liquid fuel draw-up capacity. Although it is lower in heat-resistance than the wick 6 composed of ceramic fiber, it can be made into a wick 6 sufficiently capable of enduring use by, for example, forming it with a heat-resistant, porous skin layer 8 using sodium silicate as the binder. During burning, flame shape and flame length change characteristics similar to those of a wick 6 made of ceramic fiber were obtained.

[0082] Tests 1-7 for confirming the effect of the invention wick will now be set out. The wicks used in Tests 1-6 were a slender bar-shaped ones obtained by adding a binder to ceramic fiber having a fiber diameter of 2.8μm, forming and solidifying the result into the shape of a board of 3mm thickness, and cutting the board into widths of 4mm. The flame-producing section and the draw-up section were formed integrally of the same material. The wick was installed in the

test burner 100 of Figure 7, the fuel tank 2 of the test burner 100 was stuffed with stuffing 3 composed of polypropylene fiber that was impregnated with liquid fuel added with 95wt% of anhydrous ethanol and 5wt% of hexane, the draw-up section 62 of the wick 6 was inserted into the stuffing 3, the flame-producing section 61 was projected upward through the wick holder 7 provided in the upper wall of the fuel tank 2, and an air passage 20 was formed in the upper wall of the fuel tank 2. The flame-producing section 61 of the wick 6 was formed on its outer periphery with one of various skin layers 8 over a range of 10mm from its upper end, whereafter the test was carried out.

<Test 1>

[0083] The skin layer in this test was the same as that of the first embodiment. Specifically, it was formed by mixing 50wt% of sodium silicate with 50wt% of water and stirring and mixing 70wt% of this waterglass solution with 30wt% of titanium dioxide and applying and drying the result to coat the wick surface with a gas permeable porous coating of 0.3mm thickness. The projection length of the flame-producing section of the wick from the wick holder was 3mm. The flame length change and the flame thickness after lighting were measured and compared with those of a wick not formed with such a skin layer.

[0084] The measurement results are shown in Figure 8. The initial flame length immediately after lighting was about 20mm in the case of the invention, short compared with the approximately 27mm of the comparison. However, the ensuing flame length growth was rapid in the case of the invention, with the flame of the comparison having reached 35mm and the invention wick 41mm at 10 seconds after lighting. The saturated flame lengths thereafter were 48mm for the comparison and 41mm for the invention.

[0085] On the other hand, the flame thickness was 7mmϕ for the invention, thin compared with 13mmϕ for the comparison. In addition, the flame was colored lantern-yellow and its shape was made easy to discern owing to the flame coloring reaction produced by the sodium in the sodium silicate of the binder. Burning characteristics appropriate for the case of use in a fire-lighting device, particularly a cigarette lighter, were thus exhibited.

<Text 2>

[0086] The skin layer in this test was the same as that of the first embodiment in all respects other than that the sodium silicate was changed to potassium silicate.

[0087] The measurement results are shown in Figure 8. The flame length change pattern was similar to that in Test 1. The initial flame length was 18mm, the flame length after 10 seconds and the saturated flame length were about 38mm, and the flame thickness was 7mm. A thin and long flame shape was thus obtained.

<Test 3>

[0088] The skin layer in this test was the same as that of the second embodiment. Specifically, it was formed by applying and sintering as a coating solution what was obtained by mixing 80wt% of glass frit (SiO_2 : 10%, ZnO : 65% and B_2O_3 : 25%) and 20wt% of titanium dioxide. In other aspects it was the same as that of Test 1. The measurement results are shown in Figure 9.

[0089] Also in this test, the flame length change pattern was similar to that in Test 1. The initial flame length was 20mm, the flame length after 10 seconds and the saturated flame length were about 40mm, and the flame thickness was 7mm. A thin and long flame shape was thus obtained.

<Test 4>

[0090] In this test, the flame length change when the projection length of the flame-producing section from the wick holder was changed was measured.

[0091] The composition of the skin layer in this test was the same as that in Test 1 (first embodiment). The time-course change in flame length during burning was measured when the projection length of the flame-producing section from the wick holder was varied between 1mm and 4mm. The results are shown in Figure 10. The relationship between the saturated flame length and the projection length is shown in Figure 11.

[0092] The saturated flame length grew longer with increasing length of the projection length of the flame-producing section. This was because volatized fuel gas from the side surfaces corresponding to the projection length of the flame-producing section was added to the volatized fuel gas from the tip end surface of the wick. However, owing to the cross-sectional area and the liquid fuel draw-up capacity of the wick with increasing length of the projection length, the saturated flame length was not proportional to the projection length but reached a limit (see Figure 11).

[0093] In view of this, regarding the wick, the projection length thereof is set, in accordance with its thickness and draw-up capacity, so that the saturated flame length considered to be required by the fire-lighting device is obtained

up to the vicinity where the saturated flame length reaches its limit. Compared with a wick not provided with a skin layer on the outer periphery of the flame-producing section, this also enables the projection length of the flame-producing section from the wick holder to be shortened and is advantageous from the aspect of design. Specifically, in the case of providing a closure cap for sealing the tip portion of the wick so that fuel does not volatize during storage of the burner, the projection length of the wick can be shortened to facilitate structural design.

<Test 5>

[0094] In this test, the change in amount of fuel consumption owing to formation of the skin layer was determined. The configuration of the skin layer and other features in the test were the same as those in Test 1.

[0095] For this test, first, the flame-producing section of the wick was lit, and burning was allowed to continue for 2.5 seconds and then extinguished, whereafter the wick was sealed and allowed to stand for 5 seconds. Twenty-five repetitions of the process was defined as one cycle. Since the temperature of the flame-producing section was high after the repeated lightings of one cycle, the next one cycle of repeated lightings was conducted after 5 minutes' standing with the wick kept sealed, to return the temperature to normal. Lighting cycles were carried out until the 3.3g of liquid fuel contained in the fuel tank at the start of the test no longer ignited at the wick. The amount of fuel consumed per ignition was calculated from the total number of lightings and the total amount of fuel consumed (initial amount of fuel - amount of fuel left) at this time. The results are shown in Table 1 below. ("Amount of fuel left" means fuel that was retained in the stuffing but could not be drawn up.)

[0096] The wick having the skin layer of this invention suppressed fuel volatization from the side surfaces of the flame-producing section, thereby thinning the flame thickness, so that its fuel consumption was greatly reduced compared with that of the comparative example.

[0097] The burning period was set at 2.5 seconds in this test because the flame length immediately after lighting differs between a wick provided with the skin layer and one not provided therewith, as pointed out earlier, but becomes the same, at 28mm, at 2.5 seconds after lighting (see Figure 8). The burning period was therefore set to this time period. This time period is also appropriate from the practical aspect because, in the case of a cigarette lighter, the burning time for lighting a cigarette is ordinarily within 2.5 seconds.

Table 1

Item Wick	Lightings (times)	Initial fuel (g)	Fuel left (g)	Fuel consumed (mg/times)
Comparison	250	3.3	0.3	12.2
Invention	420	3.3	0.4	6.9

<Test 6>

[0098] In this test, the relationship between the thickness of the skin layer and flame length was determined. The skin layer in this test had the same composition as that in Test 1 and features other than the skin layer were similarly formed.

[0099] Burning test was conducted at skin layer thickness varied from 0.1mm to 0.7mm by varying the amount of the coating solution applied. The relationship between skin layer thickness and initial flame length, flame length after 2 seconds and saturated flame length is shown in Figure 12. The relationship between skin layer thickness and flame thickness is shown in Figure 13.

[0100] The results show that, since the skin layer thickness affects the volatization suppressing action, the various flame lengths became shorter and the flame thickness became thinner with increasing skin layer thickness, and that this action saturated and became substantially constant when the thickness exceeded 0.3mm. From this it follows that the skin layer should preferably be formed to a thickness of 0.2-0.5mm.

[0101] From tests such as the foregoing it was found that coating the flame-producing section of the wick with a porous skin layer enables the rate of flame growth from the initial flame length immediately after lighting to be increased and the saturated flame length to be held shorter than that of an uncoated one, and that the flame thickness can be simultaneously made thin.

<Test 7>

[0102] This was a lighter lighting test using the wick of the seventh embodiment. That is to say, the middle of the side surface on the side of the igniter was formed with a slit of prescribed width, the slit width was varied between 0mm (skin layer over whole surface) and 3mm (whole surface exposed). The distance to the igniter and the height was also varied. The material etc. of the fiber wick and the skin layer were the same as those of the seventh embodiment. The results of the lighting test are shown in Figures 14A-14E and Figures 15A-15E.

[0103] Regarding the distance from the igniter, the distance L from the center of contact between the flint and the rotating striker wheel to the center line of the wick was varied between 7mm and 12mm in increments of 1mm. The diameter of the rotating striker wheel was 6mm, the diameter of the side wheels was 8mm and the diameter of the flint was 2mm. The height H was defined with respect to the location of the upper end of the wick, locations of the contact point between the rotating striker wheel and the flint moved upward and downward being defined as positive and negative, respectively. The height H at distance L was varied between - 2mm and 6mm in increments of 1mm.

[0104] Figures 14A-14E are cases where a slit was formed in the skin layer of a compressed surface of the wick and disposed to face the igniter. Figures 15A-15E are cases where a slit was formed in the skin layer of a cut surface perpendicular to the compressed surfaces and disposed to face the igniter.

[0105] The lighting test was conducted with the wick and the igniter in the positional relationships of the test range bound by solid lines. The good lighting range, in which ignition occurred after one or two lighting operations, is indicated as blank and the poor lighting range, in which three or more lighting operations were needed before lighting, is indicated as hatched.

[0106] Figures 14A-14E and Figures 15A-15E show that good igniting performance is obtained over a wide range when a slit of a slit width of about 1mm or greater is formed. They also show that the range within which lighting is possible is greater when a cut surface of the wick is directed toward the igniter than when a compressed surface is so directed.

Claims

1. In a liquid fuel burner (1) wherein liquid fuel is impregnated in stuffing (3) accommodated in a fuel tank (2) and which is equipped with a wick (6, 60) with a draw-up section (62) in contact with the stuffing (3) for drawing up liquid fuel by capillarity and burning it at a tip flame-producing section (61) and an igniter (10) for lighting the flame-producing section (61),

a wick (6, 60) for liquid fuel burner which is constituted of a porous material and at least a side surface (6b) not including an upper end surface (60) of the flame-producing section (61) is provided with a skin layer (8) for suppressing volatization of liquid fuel,

characterized in that in the wick (6, 60) liquid fuel volatization suppressing action at a side surface (6b) on the side of the igniter (10) is smaller than volatization suppressing action at other side surfaces.

2. A wick (6, 60) according to claim 1, **characterized in that** the side surface of the wick (6, 60) on the side of the igniter (10) is partially formed with the skin layer (8).

3. A wick (6, 60) according to claim 1, **characterized in that** the side surface of the wick (6, 60) on the side of the igniter (10) is not formed with the skin layer (8).

4. A wick (6, 60) according to claim 1, **characterized in that** the skin layer (8) is a porous coating having lower liquid fuel permeability than the permeability at the wick interior.

5. A wick (6, 60) according to claim 1, **characterized in that** the skin layer (8) is constituted by application of or immersion in what is obtained by mixing a metal oxide powder and a binder, and solidification by drying.

6. A wick (6, 60) according to claim 5, **characterized in that** the metal oxide powder includes at least one of titanium oxide and aluminum oxide.

7. A wick (6, 60) according to claim 1, **characterized in that** the skin layer (8) is constituted by application of or immersion in what is obtained by mixing a heat-resistant inorganic compound powder, a metal powder or a mixture thereof and a binder, and solidification by drying.

8. A wick (6, 60) according to claim 5 or 7, **characterized in that** the binder is a waterglass material composed of sodium silicate, potassium silicate or the like.

9. A wick (6, 60) according to claim 5 or 7, **characterized in that** the binder is a low-melting-point glass material.

10. A wick (6, 60) according to claim 1, **characterized in that** the skin layer (8) is constituted by application of or immersion in a heat-resistant paint, and drying.

11. A wick (6, 60) according to claim 1, **characterized in that** the skin layer (8) contains a metal compound exhibiting a f lame coloring reaction.

12. A wick (6, 60) according to claim 1, **characterized in that** the skin layer (8) is added with carbon.

13. A wick (6, 60) according to claim 1, **characterized in that** after formation the skin layer (8) is applied with a coating solution containing carbon.

14. A wick (6, 60) according to claim 1, **characterized in that** liquid fuel permeability of the skin layer (8) differs between an upper end and other portions of the flame-producing section (61).

15. A wick (6, 60) according to claim 14, **characterized in that** the skin layer (8) differs in thickness between the upper end and other portions of the flame-producing section (61).

16. A wick (6, 60) according to claim 1, **characterized in that** the skin layer (8) has a thickness of 0.2mm-0.5mm.

17. A wick (6, 60) according to claim 1, **characterized in that** the wick (6, 60) is formed of a heat-resistant material such as ceramic fiber or glass fiber to have a bar-like shape of rectangular cross-section.

18. A wick (6, 60) according to claim 1, **characterized in that** the wick (6, 60) is composed of a porous ceramic or porous glass material.

19. A wick (6, 60) according to claim 1, **characterized in that** a tip end surface of the wick (6, 60) provided with the skin layer (8) is formed as an inclined surface and the inclined surface is disposed to face the igniter (10).

20. A wick (6, 60) according to claim 1 or 17, **characterized in that** the wick (6, 60) is constituted of a porous material compression-formed in a direction perpendicular to an axial direction of the wick (6, 60) and a surface compressed during the . compression-forming is disposed to face the igniter (10) when the formation of the skin layer (8) makes overall amount of volatization from the side surfaces large.

21. A wick (6, 60) according to claim 1 or 17, **characterized in that** the wick (6, 60) is constituted of a porous material compression-formed in a direction perpendicular to an axial direction of the wick (6, 60) and a surface perpendicular to a surface compressed during compression-forming is disposed to face the igniter (10) when the formation of the skin layer (8) makes overall amount of volatization from the side surfaces small.

Patentansprüche

1. In einem Flüssigbrennstoffbrenner (1), in welchem flüssiger Brennstoff in einer imprägnierten Füllung (3) in einem Brennstofftank (2) aufgenommen ist, und bei dem ein Docht (6, 60) mit einem Hochziehteil (62) in Berührung mit der Füllung (3) steht, um flüssigen Brennstoff durch Kapillarwirkung hochzuziehen und ihn an einem am Ende befindlichen Flammenerzeugungsteil (61) zu verbrennen, und mit einer Zündvorrichtung (10) zum Entzünden des Flammenerzeugungsteils (61),
ein Docht (6, 60) für den Flüssigbrennstoffbrenner, gebildet aus einem porösen Material und mindestens einer Seitenfläche (6b), die keine obere Stirnfläche (6a) des Flammenerzeugungsteils (61) enthält, ausgestattet mit einer Hautschicht (8) zum Unterdrücken der Verflüchtigung des flüssigen Brennstoffs,
dadurch gekennzeichnet, daß in dem Docht (6, 60) die Wirkung zum Unterdrücken der Verflüchtigung des flüssigen Brennstoffs auf einer Seitenfläche (6b) an der Seite der Zündvorrichtung (10) geringer ist als die Wirkung der Unterdrückung der Verflüchtigung auf den anderen Seiten.

2. Docht (6, 60) nach Anspruch 1, **dadurch gekennzeichnet, daß** die Seitenfläche des Dochts (6, 60) auf der Seite der Zündvorrichtung (10) teilweise mit der Hautschicht (8) ausgebildet ist.

3. Docht (6, 60) nach Anspruch 1, **dadurch gekennzeichnet, daß** die Seitenfläche des Dochts (6, 60) auf der Seite der Zündvorrichtung (10) nicht mit der Hautschicht (8) ausgebildet ist.

4. Docht (6, 60) nach Anspruch 1, **dadurch gekennzeichnet, daß** die Hautschicht (8) ein poröser Überzug ist, der eine geringere Durchlässigkeit für flüssigen Brennstoff besitzt als das Docht-Innere.

5. Docht (6, 60) nach Anspruch 1, **dadurch gekennzeichnet, daß** die Hautschicht (8) gebildet ist durch Auftragen oder Eintauchen in eine Masse, die man erhält durch Mischen eines Metalloxidpulvers und eines Bindemittels und Verfestigen dieses Gemisches durch Trocknen.

6. Docht (6, 60) nach Anspruch 5, **dadurch gekennzeichnet, daß** das Metalloxidpulver mit Titanoxid und/oder Aluminiumoxid enthält.

7. Docht (6, 60) nach Anspruch 1, **dadurch gekennzeichnet, daß** die Hautschicht (8) gebildet wird durch Auftragen einer Masse oder Eintauchen in eine Masse, die man erhält durch Mischen eines hitzebeständigen anorganischen Verbindungspulvers, eines Metallpulvers oder eines Gemisches daraus einerseits und eines Bindemittels andererseits und durch Verfestigen mittels Trocknung.

8. Docht (6, 60) nach Anspruch 5 oder 7, **dadurch gekennzeichnet, daß** das Bindemittel ein Wasserglas-Material ist, zusammengesetzt aus Natriumsilicat, Kaliumsilicat oder dergleichen.

9. Docht (6, 60) nach Anspruch 5 oder 7, **dadurch gekennzeichnet, daß** das Bindemittel ein Glasmaterial mit niedrigem Schmelzpunkt ist.

10. Docht (6, 60) nach Anspruch 1, **dadurch gekennzeichnet, daß** die Hautschicht (8) gebildet wird durch Aufbringen einer oder Eintauchen in eine hitzebeständige Anstrichmasse und Trocknen.

11. Docht (6, 60) nach Anspruch 1, **dadurch gekennzeichnet, daß** die Hautschicht (8) eine Metallverbindung enthält, die eine Flammen-Anfärbereaktion zeigt.

12. Docht (6, 60) nach Anspruch 1, **dadurch gekennzeichnet, daß** die Hautschicht (8) mit Kohlenstoff versetzt ist.

13. Docht (6, 60) nach Anspruch 1, **dadurch gekennzeichnet, daß** nach der Bildung der Hautschicht (8) diese mit einer kohlenstoffhaltigen Überzuglösung versehen wird.

14. Docht (6, 60) nach Anspruch 1, **dadurch gekennzeichnet, daß** die Durchlässigkeit der Hautschicht (8) für flüssigen Brennstoff zwischen dem oberen Ende und anderen Bereichen des Flammenerzeugungsteils (61) verschieden ist.

15. Docht (6, 60) nach Anspruch 14, **dadurch gekennzeichnet, daß** die Hautschicht (8) sich in der Dicke unterscheidet zwischen dem oberen Ende und anderen Bereichen des Flammenerzeugungsteils (61).

16. Docht (6, 60) nach Anspruch 1, **dadurch gekennzeichnet, daß** die Hautschicht (8) eine Dicke von 0,2 mm bis 0,5 mm besitzt.

17. Docht (6, 60) nach Anspruch 1, **dadurch gekennzeichnet, daß** der Docht (6, 60) aus einem hitzebeständigen Material wie zum Beispiel Keramikfasern oder Glasfasern gebildet ist, und eine stabförmige Gestalt mit rechtekkigem Querschnitt besitzt.

18. Docht (6, 60) nach Anspruch 1, **dadurch gekennzeichnet, daß** der Docht (6, 60) sich aus einem porösen Keramikmaterial oder einem porösen Glasmaterial zusammensetzt.

19. Docht (6, 60) nach Anspruch 1, **dadurch gekennzeichnet, daß** eine vordere Stirnfläche des Dochts (6, 60), die mit der Hautschicht (8) versehen ist, als Schrägfläche ausgebildet ist, und daß die Schrägfläche so angeordnet ist, daß sie der Zündvorrichtung (10) zugewandt ist.

20. Docht (6, 60) nach Anspruch 1 oder 17, **dadurch gekennzeichnet, daß** der Docht (6, 60) aus einem porösen Material gebildet ist, welches unter Druck in eine Richtung rechtwinklig zur axialen Richtung des Dochts (6, 60) geformt ist, und sich eine während der Druckformung gepreßte Oberfläche in einer solchen Lage befindet, daß sie der Zündvorrichtung (10) zugewandt ist, wenn die Ausbildung der Hautschicht (8) dazu führt, daß die Gesamtmenge der Verflüchtigung aus den Seitenflächen groß ist.

21. Docht (6, 60) nach Anspruch 1 oder 17, **dadurch gekennzeichnet, daß** der Docht (6, 60) aus einem porösen Material gebildet ist, welches in einer Richtung rechtwinklig zur axialen Richtung des Dochts (6, 60) durch Druck geformt ist, und eine Fläche rechtwinklig zu einer während der Druckformung gepreßten Fläche so gelegen ist, daß sie der Zündvorrichtung (10) gegenüberliegt, wenn die Bildung der Hautschicht (8) dazu führt, daß die Gesamt-Verflüchtigungsmenge von den Seitenflächen gering ist.

Revendications

1. Dans un brûleur (1) à carburant liquide dans lequel le carburant liquide est imprégné dans une matière de bourrage (3) logée dans un réservoir de carburant (2) et qui est équipé d'une mèche (6, 60) présentant une partie étirée (62) en contact avec la matière de bourrage (3) pour aspirer par capillarité du carburant liquide et le brûler à une partie de pointe (61) produisant la flamme et d'un allumeur (10) pour allumer la partie (61) produisant la flamme, une mèche (6, 60) pour brûleur à carburant liquide et qui est constituée d'un matériau poreux et d'au moins une surface latérale (6b) ne comprenant pas la surface d'extrémité supérieure (60) de la partie (61) produisant la flamme, est munie d'une couche de peau (8) pour supprimer la vaporisation du carburant liquide, et est **caractérisée en ce que**, dans la mèche (6, 60), l'action de suppression de la vaporisation du carburant liquide sur une surface latérale (6b) du côté de l'allumeur (10) est plus faible que l'action de suppression de la vaporisation sur les autres surfaces latérales.

2. Une mèche (6, 60) selon la revendication 1, **caractérisée en ce que** la surface latérale de la mèche (6, 60) du côté de l'allumeur (10) est partiellement formée avec la couche de peau (8).

3. Une mèche (6, 60) selon la revendication 1, **caractérisée en ce que** la surface latérale de la mèche (6, 60) du côté de l'allumeur (10) n'est pas formée avec la couche de peau (8).

4. Une mèche (6, 60) selon la revendication 1, **caractérisée en ce que** la couche de peau (8) est un revêtement poreux présentant une perméabilité au carburant liquide plus faible que la perméabilité à l'intérieur de la mèche.

5. Une mèche (6, 60) selon la revendication 1, **caractérisée en ce que** la couche de peau (8) est constituée par l'application de ou l'immersion dans ce qui est obtenu en mélangeant une poudre d'oxyde métallique et un liant, et en réalisant la solidification par séchage.

6. Une mèche (6, 60) selon la revendication 5, **caractérisée en ce que** la poudre d'oxyde métallique comprend au moins l'un parmi l'oxyde de titane et l'oxyde d'aluminium.

7. Une mèche (6, 60) selon la revendication 1, **caractérisée en ce que** la couche de peau (8) est constituée par l'application de ou l'immersion dans ce qui est obtenu en mélangeant une poudre composite minérale et résistante à la chaleur, une poudre métallique ou leur mélange et un liant, et en réalisant la solidification par séchage.

8. Une mèche (6, 60) selon la revendication 5 ou 7, **caractérisée en ce que** le liant est un matériau de verre soluble composé de silicate de sodium, de silicate de potassium ou similaire.

9. Une mèche (6, 60) selon la revendication 5 ou 7, **caractérisée en ce que** le liant est un matériau de verre soluble à bas point de fusion.

10. Une mèche (6, 60) selon la revendication 1, **caractérisée en ce que** la couche de peau (8) est constituée par application de, ou immersion dans une peinture résistante à la chaleur, et séchage.

11. Une mèche (6, 60) selon la revendication 1, **caractérisée en ce que** la couche de peau (8) contient un composé métallique présentant une réaction colorant la flamme.

12. Une mèche (6, 60) selon la revendication 1, **caractérisée en ce que** la couche de peau (8) reçoit une addition de carbone.

13. Une mèche (6, 60) selon la revendication 1, **caractérisée en ce qu'**après sa formation, la couche de peau (8) reçoit une application d'une solution de revêtement contenant du carbone.

14. Une mèche (6, 60) selon la revendication 1, **caractérisée en ce que** la perméabilité au carburant liquide de la couche de peau (8) diffère entre l'extrémité supérieure et d'autres portions de la partie (61) produisant la flamme.

15. Une mèche (6, 60) selon la revendication 14, **caractérisée en ce que** la couche de peau (8) présente une différence d'épaisseur entre l'extrémité supérieure et d'autres portions de la partie (61) produisant la flamme.

16. Une mèche (6, 60) selon la revendication 1, **caractérisée en ce que** la couche de peau (8) présente une épaisseur de 0,2 mm à 0,5 mm.

17. Une mèche (6, 60) selon la revendication 1, **caractérisée en ce que** la mèche (6, 60) est formée d'un matériau résistant à la chaleur tel que de la fibre céramiques ou des fibres de verre pour présenter une forme de barre à section transversale rectangulaire.

18. Une mèche (6, 60) selon la revendication 1, **caractérisée en ce que** la mèche (6, 60) est composée d'un matériau de céramique poreuse ou de verre poreux.

19. Une mèche (6, 60) selon la revendication 1, **caractérisée en ce que** la surface d'extrémité de pointe de la mèche (6, 60) munie de la couche de peau (8) est formée comme une surface inclinée qui est disposée en face de l'allumeur (10).

20. Une mèche (6, 60) selon la revendication 1 ou 17, **caractérisée en ce que** la mèche (6, 60) est constituée d'un matériau poreux formé par compression dans une direction perpendiculaire à la direction axiale de la mèche (6, 60) et **en ce qu'**une surface comprimée pendant le formage par compression est disposée en face de l'allumeur (10) lorsque la formation de la couche de peau (8) fait en sorte que la quantité globale de vaporisation en provenance des surfaces latérales soit importante.

21. Une mèche (6, 60) selon la revendication 1 ou 17, **caractérisée en ce que** la mèche (6, 60) est constituée d'un matériau poreux formé par compression dans une direction perpendiculaire à la direction axiale de la mèche (6, 60) et **en ce qu'**une surface perpendiculaire à une surface comprimée pendant le formage par compression est disposée en face de l'allumeur (10) lorsque la formation de la couche de peau (8) fait en sorte que la quantité globale de vaporisation en provenance des surfaces latérales soit réduite.

FIG.1A

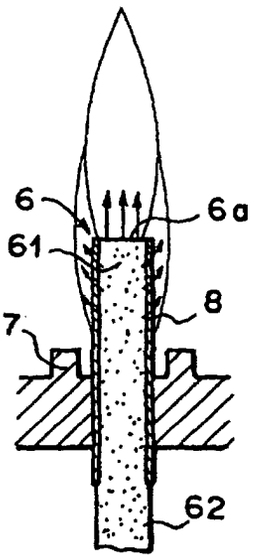

FIG.1B

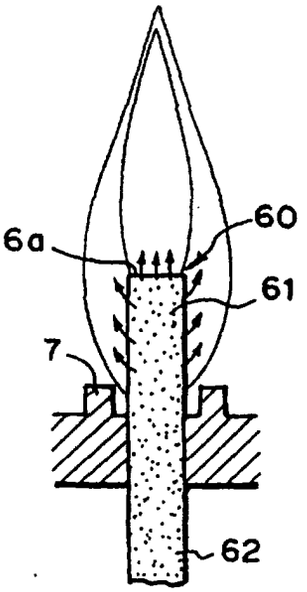

FIG.2

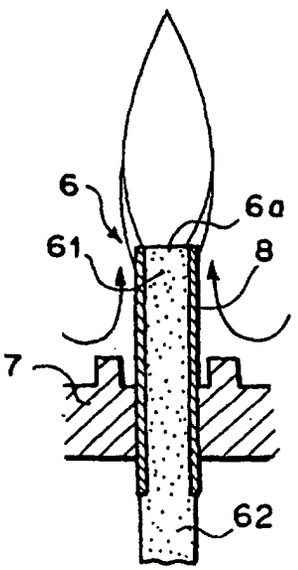

FIG. 3

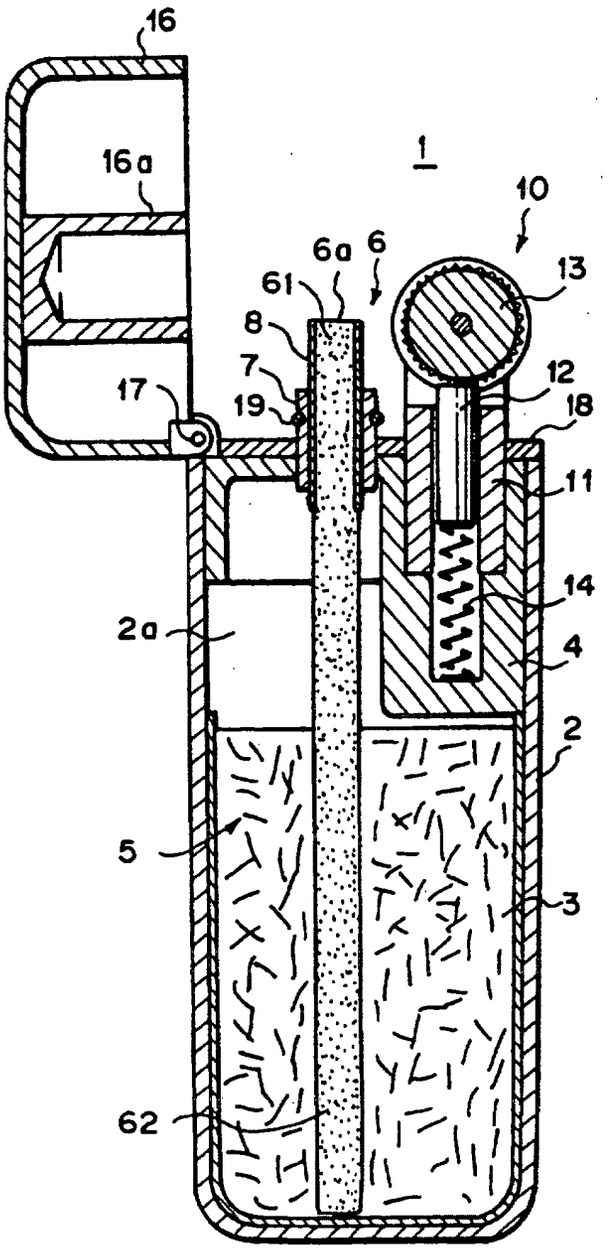

FIG. 4

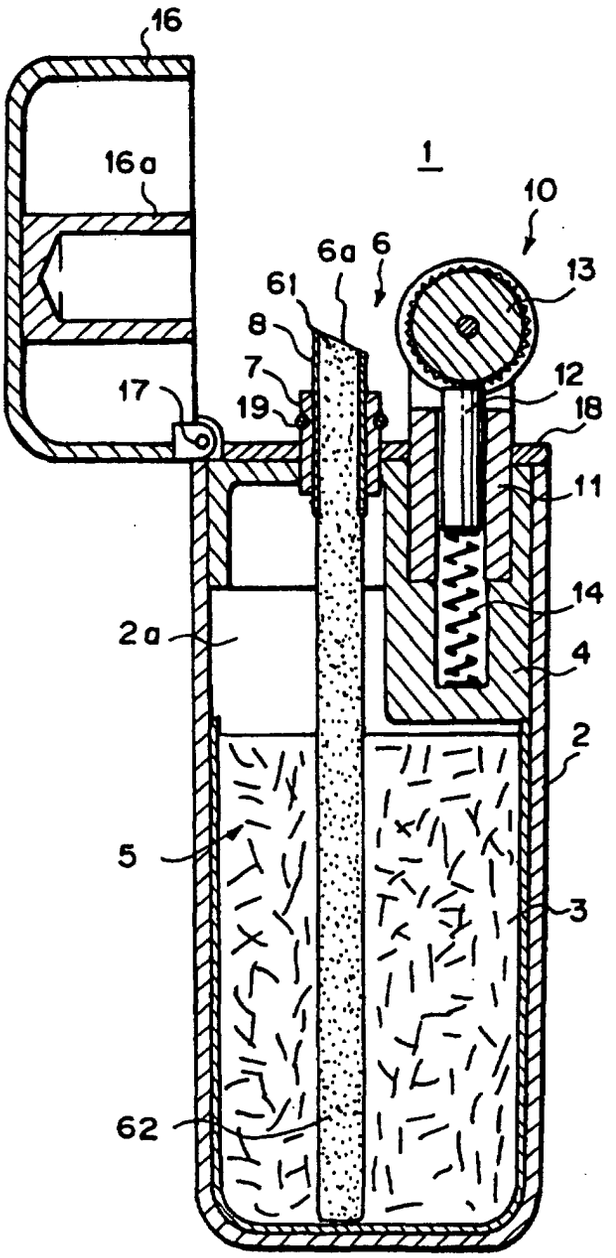

FIG. 5

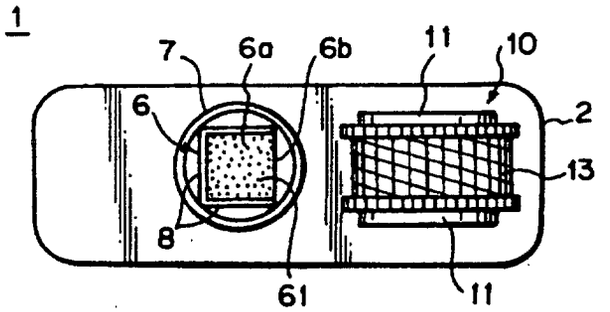

FIG. 6

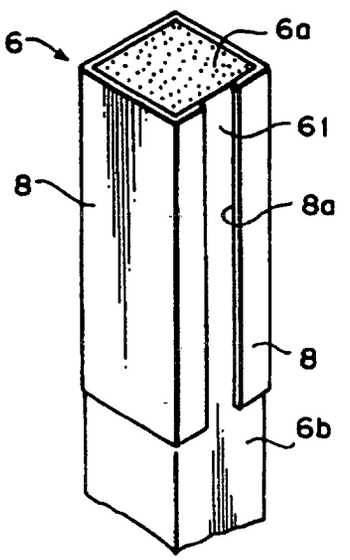

FIG.7

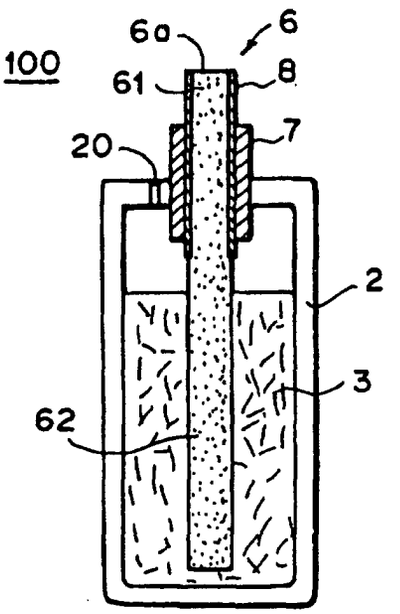
100
60
6
61
8
20
7
2
3
62

FIG.8

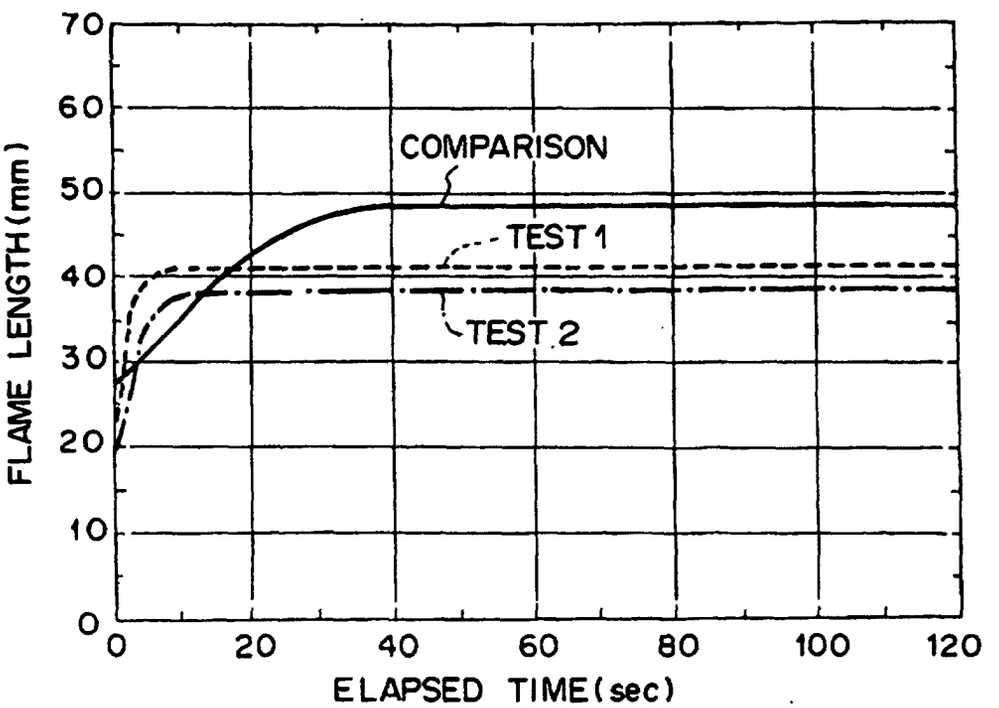
70
60
50
40
30
20
10
0
FLAME LENGTH(mm)
COMPARISON
TEST 1
TEST 2
0
20
40
60
80
100
120
ELAPSED TIME(sec)

FIG. 9

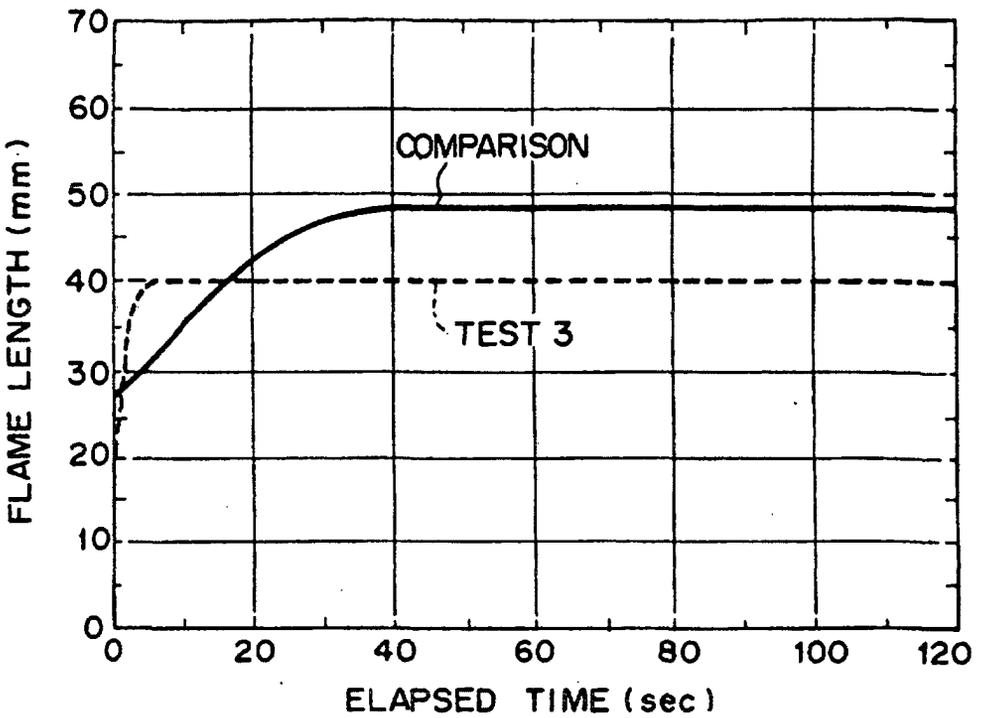
70
60
50
40
30
20
10
0
FLAME LENGTH (mm)
COMPARISON
TEST 3
0
20
40
60
80
100
120
ELAPSED TIME (sec)

FIG. 10

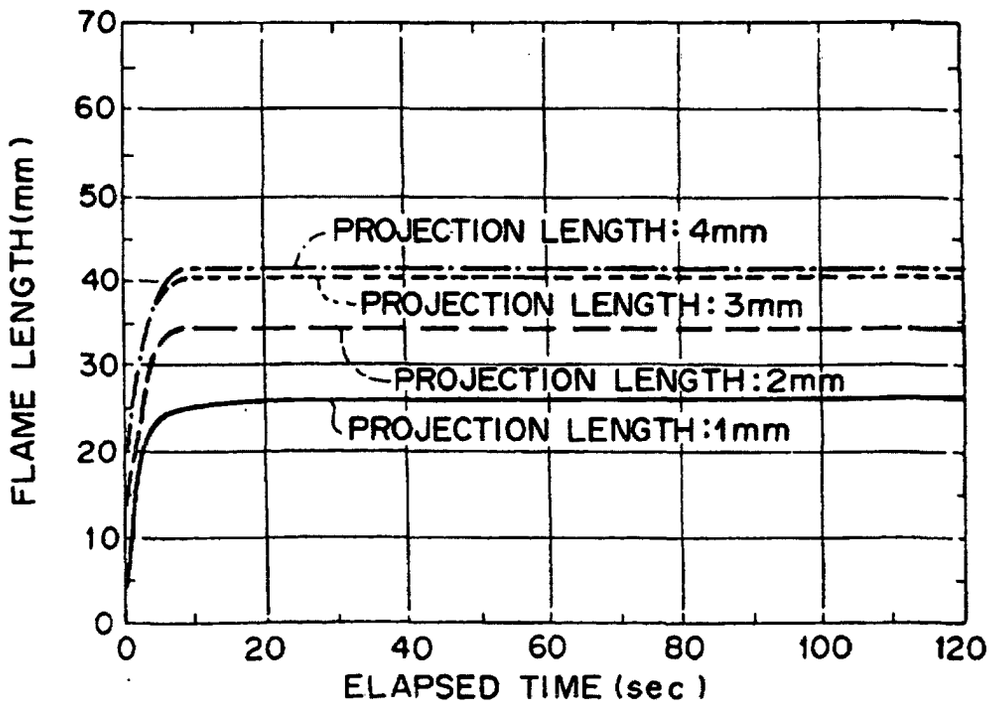
70
60
50
40
30
20
10
0
FLAME LENGTH(mm)
PROJECTION LENGTH: 4mm
PROJECTION LENGTH: 3mm
PROJECTION LENGTH: 2mm
PROJECTION LENGTH: 1mm
0
20
40
60
80
100
120
ELAPSED TIME (sec)

FIG.11

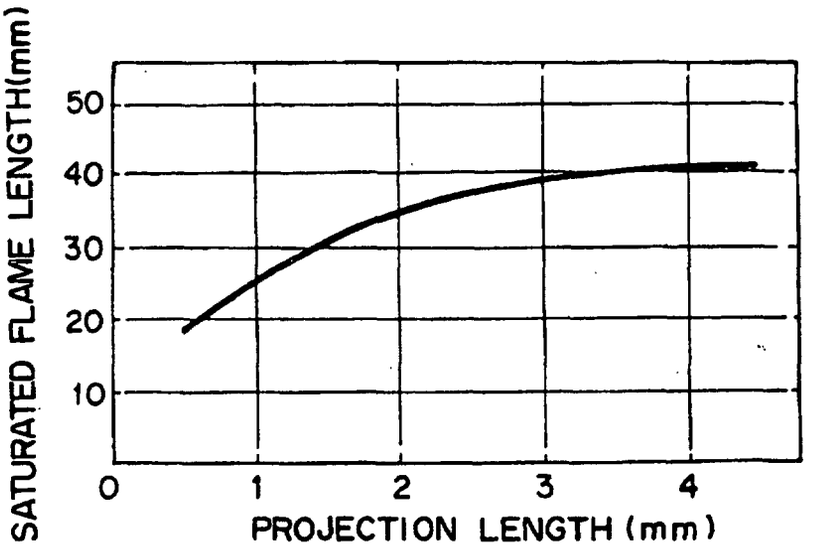
SATURATED FLAME LENGTH(mm)
50
40
30
20
10
0
1
2
3
4
PROJECTION LENGTH (mm)

FIG.12

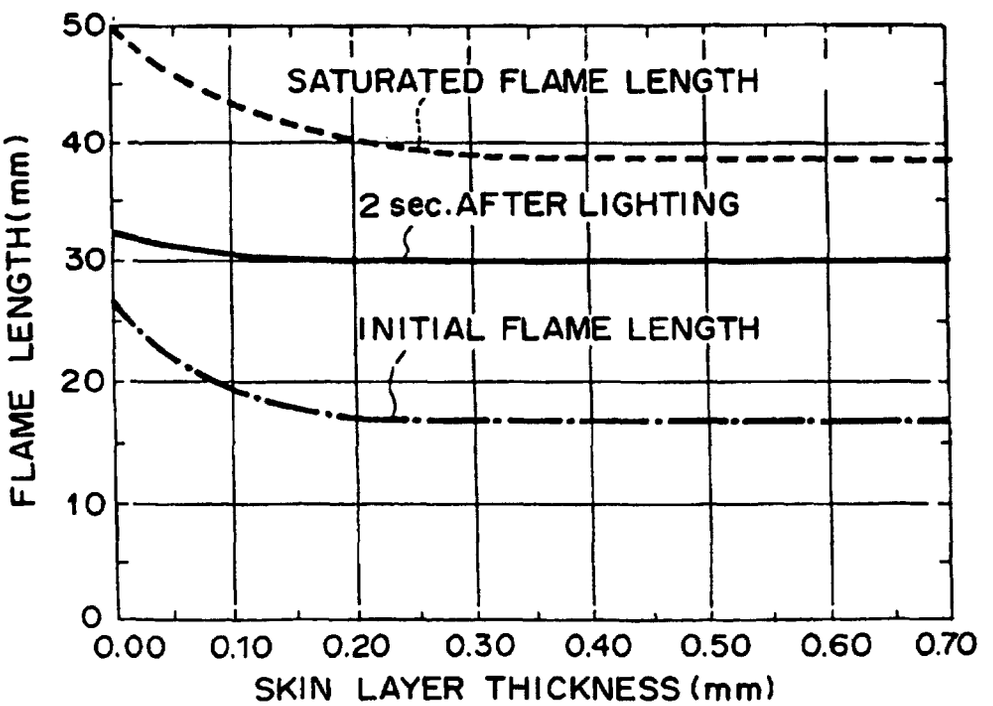
FLAME LENGTH(mm)
50
40
30
20
10
0
SATURATED FLAME LENGTH
2 sec. AFTER LIGHTING
INITIAL FLAME LENGTH
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
SKIN LAYER THICKNESS (mm)

FIG.13

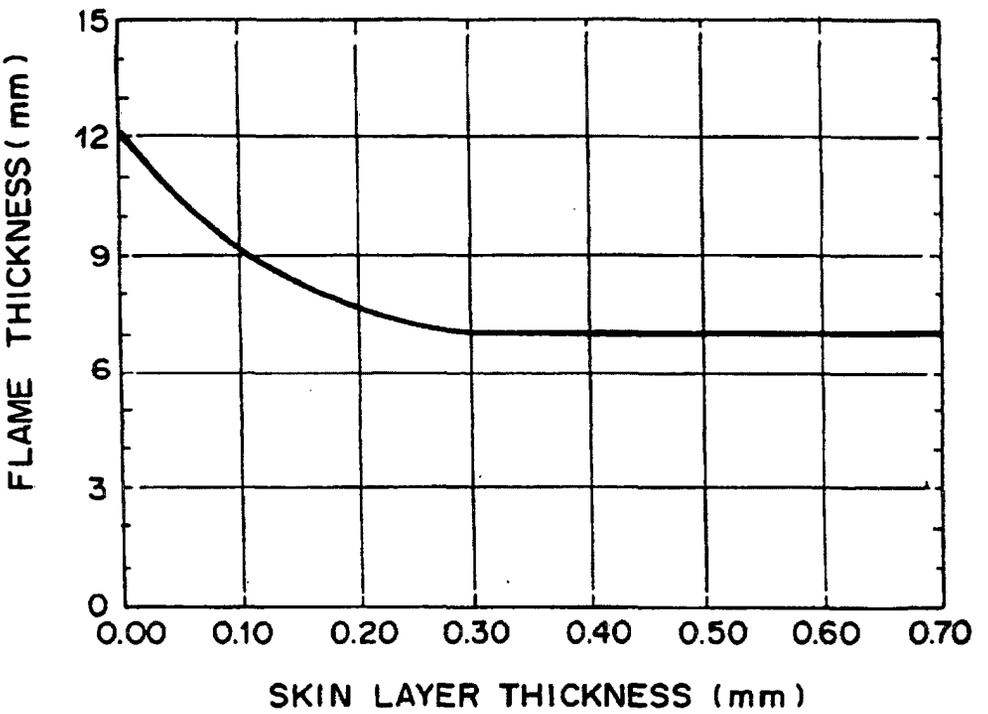
FLAME THICKNESS (mm)
15
12
9
6
3
0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
SKIN LAYER THICKNESS (mm)

FIG.14A

SLIT WIDTH:0.0mm

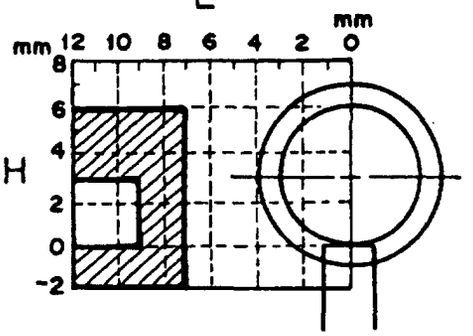

FIG.14B

SLIT WIDTH:0.5mm

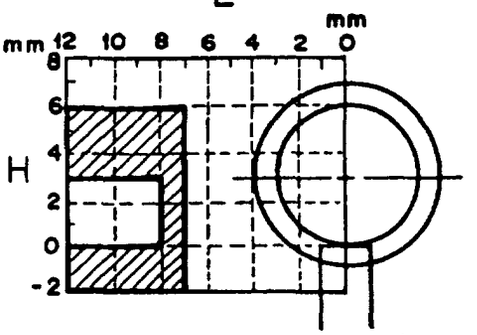

FIG.14C

SLIT WIDTH:1.0mm

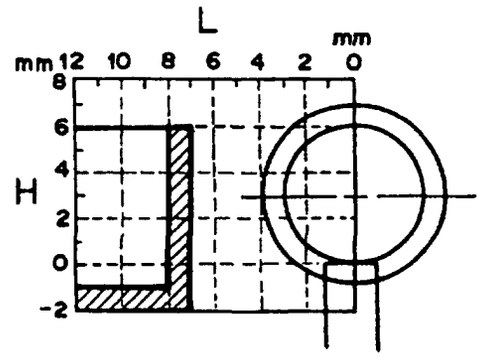

FIG.14D

SLIT WIDTH:2.0mm

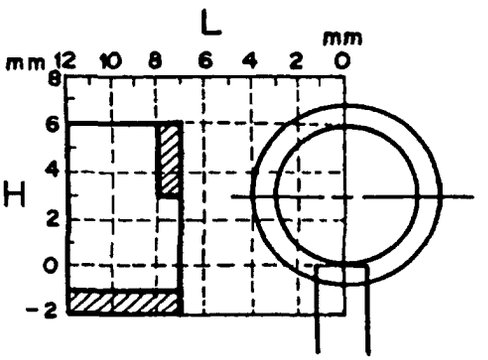

FIG.14E

SLIT WIDTH:3.0mm

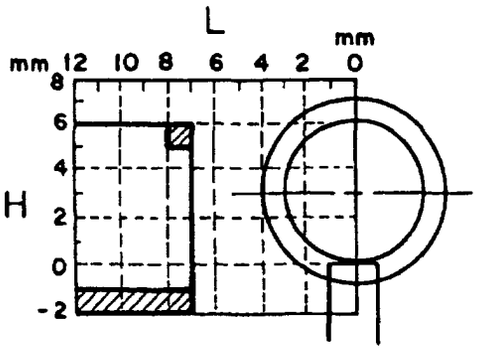

FIG.15A

SLIT WIDTH:0.0mm

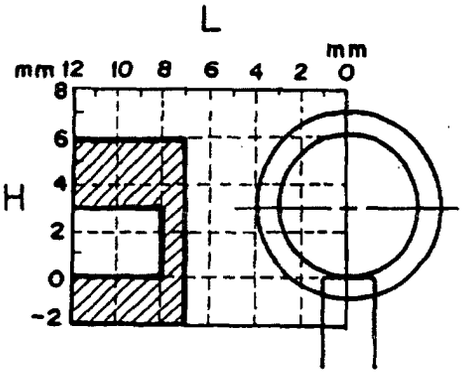

FIG.15B

SLIT WIDTH:0.5mm

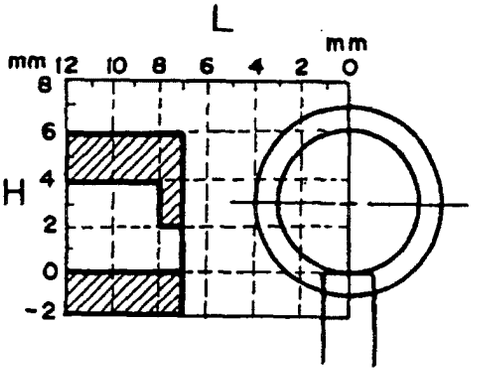

FIG.15C

SLIT WIDTH:1.0mm

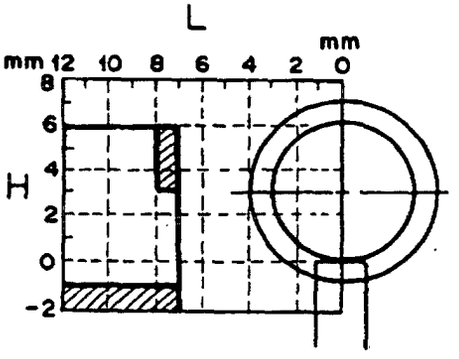

FIG.15D

SLIT WIDTH:2.0mm

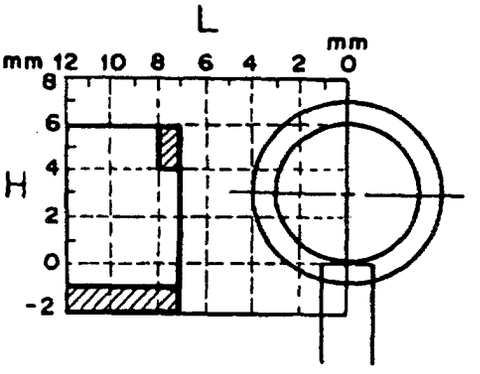

FIG.15E

SLIT WIDTH:3.0mm