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L. BODDY

2,612,432

VAPORIZER

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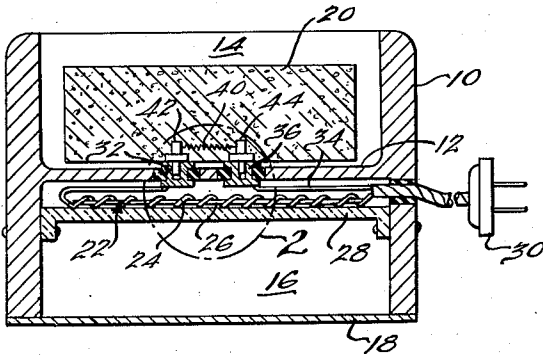


FIG. 1.

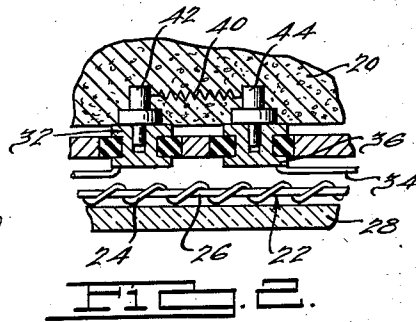


FIG. 2.

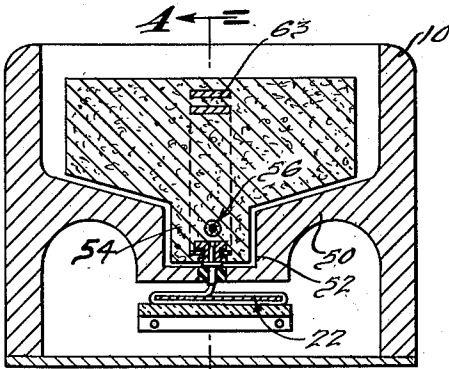


FIG. 3.

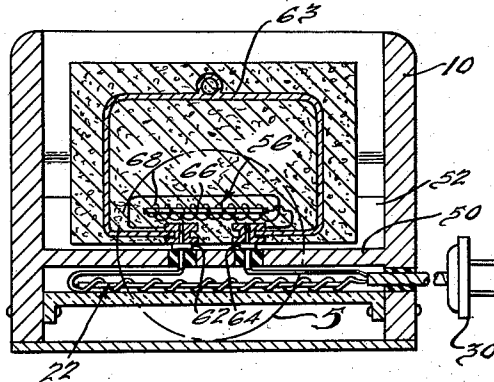


FIG. 4.

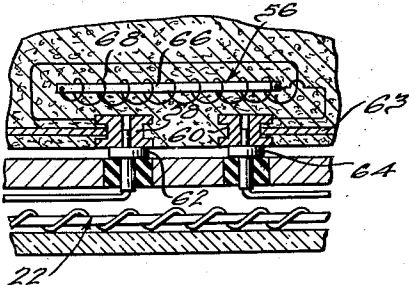


FIG. 5.

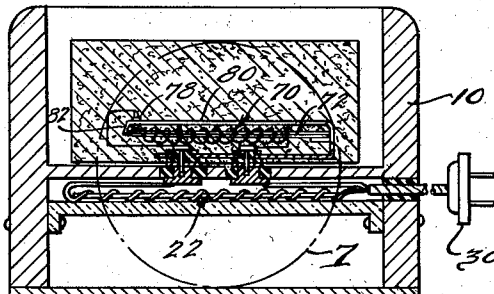


FIG. 6.

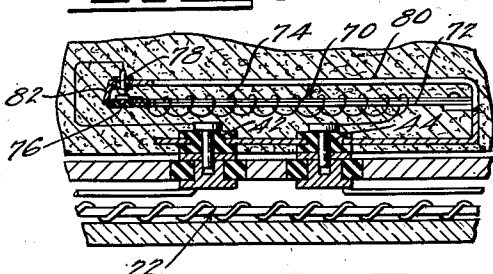


FIG. 7.

INVENTOR.

Leonard Boddy.

BY

Harniss, Dickey & Pierce.
ATTORNEYS.

UNITED STATES PATENT OFFICE

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VAPORIZER

Leonard Boddy, Ann Arbor, Mich., assignor to
King-Seeley Corporation, Ann Arbor, Mich., a
corporation of Michigan

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26 Claims. (Cl. 21-119)

1 The present invention relates to vaporizers and, in the illustrated embodiments, provides such structures wherein material containing or composed of an active ingredient is vaporized by the application of heat thereto, and wherein the heat transfer characteristics of the material are utilized to maintain the heating action during vaporization and to cause it to be automatically terminated when the vaporizing process has been carried to a predetermined degree of completion.

In the presently preferred practice of the invention, the aforesaid material is placed in a container provided with an electric heater. The heater circuit includes a thermally responsive control element which is heated as a consequence of the flow of heating current. This control element is positioned in good heat transfer relation to the material, and as specifically disclosed herein, is embedded in the body of the material. During the vaporizing action, the material serves to conduct heat away from the control element rapidly enough to maintain it below its critical operating temperature. The vaporizing action, when entirely or partially completed, however, deprives the control element of this heat transfer effect and, consequently, the temperature of the control element rises to its critical operating point and it opens the heating circuit.

The present vaporizers may, of course, be adapted for use with any of a wide variety of materials such as insecticides, deodorizers, fumigants, fungicides, and the like. In certain instances, as, for example, in the use of insecticidal paradichlorobenzene, the material may be entirely composed of the active ingredient. On the other hand, in the event the active ingredient is one which is not adapted to perform the heat transfer function, the material may be made up of the active ingredient and a carrier which is capable of performing the heat transfer function. Preferred materials are those which, while in crystal form, can readily be molded or pressed into cake-like form and which, when subjected to the heat of the vaporizer, pass through a liquid phase. While in the liquid phase, such materials serve effectively as heat transfer agents to maintain the temperature of the heating control element below the critical value.

With the foregoing considerations in view, principal objects of the present invention are to provide vaporizers wherein material composed of or containing an active ingredient is vaporized

2 by the application of heat thereto and wherein the heat transfer characteristics of the material serve to control the heating action; to provide such structures wherein heat is applied under control of an electric circuit containing a thermally responsive element which is heated as a consequence of the heating action and from which heat is transferred to the material during the vaporizing action; to provide such structures wherein the control element is directly exposed to a vaporizable material which passes through a liquid phase during the course of the vaporizing action; to provide such structures wherein the control element is initially embedded in the vaporizable material and is operatively associated with the heating control circuit as an incident to the placing of the material in the vaporizer; and to provide structures of the above indicated type which reliably maintain the heating action until the vaporizing action is completed or has progressed to a predetermined degree, and then reliably interrupt the same.

With the above as well as other and more detailed objects in view, which appear in the following description and in the appended claims, preferred but illustrative embodiments of the invention are shown in the accompanying drawings throughout the several views of which corresponding reference characters are used to designate corresponding parts, and in which:

Figure 1 is a view in vertical section of a vaporizer embodying the invention;

Fig. 2 is an enlarged view of the encircled portion of Fig. 1;

Fig. 3 is a view in vertical section of a modified form of the invention;

Fig. 4 is a view in vertical section, taken along the line 4-4 of Fig. 3;

Fig. 5 is an enlarged view of the encircled portion of Fig. 4;

Fig. 6 is a view in vertical section of another modification of the invention; and

Fig. 7 is an enlarged view of the encircled portion of Fig. 6.

Referring first to Figure 1, the vaporizer comprises generally a circular or other suitably shaped body 10 provided with an intermediate heat conducting partition 12 which divides it into upper and lower cavities 14 and 16. Cavity 16 may be closed by a wall 18, preferably removable. The open upper cavity 14 serves to receive the cake 20 of vaporizable material, and cavity 16 accommodates the heater 22.

The illustrated heater 22 is electrical, and comprises an insulated wire 24 wound upon a

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piece of insulating material 26, such as mica. Elements 24 and 26 are supported on a deck 28.

One end of wire 24 extends to one terminal of the illustrated plug 30, and the other end thereof is connected to a terminal 32 fixedly carried by the partition 12. The companion wire 34 is connected to the other terminal of the plug 30, and to a second terminal 36, fixedly carried by the partition 12.

The vaporizable cake 20 has embedded within it a fusible link 40 and a pair of companion terminals 42 and 44 which are, in turn, electrically connected to the ends of the link 40.

The cooperating pairs of terminals 32—42 and 36—44 are illustrated as being of the plug and jack type. Specifically, terminals 32 and 36 are female elements, and terminals 42 and 44 are male elements.

As aforesaid, cake 20 may be formed of or contain an active ingredient. In the case of paradichlorobenzene, for example, the entire cake may be formed of crystals of this material pressed or molded into shape, with elements 40, 42 and 44 embedded therein.

In use, and assuming that cake 20 is positioned as shown, and that the device is plugged in, it will be appreciated that current will pass through the series connected heater 22 and link 40. Heat generated by heater 22 passes through the partition 12 and is absorbed by the cake 20, thereby elevating its temperature and causing it to liquefy. The heating current also raises the temperature of the fusible link 40. The fusing temperature of this link is, however, well above the boiling point of the cake material.

With some materials, the heat conducting characteristics thereof in solid form may be such that heat is conducted away from the link 40 through the solid body too rapidly to enable the link 40 to reach the melting point of the cake material. In such cases, the liquefaction of the cake material will be due entirely to the heating effect of heater 22. The heating effect of heater 22, of course, greatly exceeds that of the link 40. In other cases, the solid cake material may not be able to conduct heat away from the link 40 fast enough to maintain it below the melting point of the cake material. In such cases, liquefaction of the cake material will take place progressively from the outside under the influence of heater 22 and progressively from the inside under the influence of link 40. In either case, the entire cake will be liquefied before link 40 approaches its fusing temperature. As aforesaid, this fusing temperature is well above the boiling point of the vaporizable material.

The continued vaporization of the material ultimately brings the level of the liquid in cavity 14 to a point below the level of link 40, exposing the latter to atmosphere. The atmosphere is, of course, a comparatively poor conductor of heat and, consequently, the continued flow of current promptly elevates link 40 to its fusing temperature and ruptures it, interrupting the heating action.

It will be understood, of course, that after rupture of the link 40 the used terminals 42 and 44 are withdrawn before the succeeding cake of vaporizable material is moved into place.

The form of the invention shown in Figures 3, 4, and 5 differs from that of Figures 1 and 2, primarily in that the vaporizable cake incorporates a handle or equivalent element to facilitate the removal of the initially embedded terminals. The fusible link and terminal structure are

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received in a well, and the fusible link is provided with a heater to better insure its maintenance below fusing temperature during vaporization, and its prompt rupture at the end of the vaporizing process.

More particularly, in Figures 3, 4, and 5, the dividing partition 50 is provided with a depressed central portion 52 which receives that part of the cake 54 which encloses the link assembly 56 and the terminals 58 and 60. In this instance, terminals 58 and 60 are illustrated as being female terminal elements, and the cooperating fixed terminals 62 and 64 are male elements.

It will be appreciated that well 52 may be deep enough and narrow enough to make it difficult for a user to touch the exposed terminals 62 and 64, thus improving the safety characteristics of the device. On the other hand, to facilitate removal of the used terminals 58 and 60, after the associated cake has been vaporized, the cake may be provided with the illustrated embedded handle 63, the lower ends of which are connected to but insulated from the terminals 58 and 60.

In this instance, the control assembly 56 comprises the fusible link 66, and a heater therefor comprising the insulated length of wire 68. Coil 68 and link 66 are connected in series between terminals 58 and 60.

As in the case of Figure 1, until such a time as the level of the vaporizable material falls below the level of the link assembly 56, the temperatures of elements 66 and 68 are maintained well below the fusing temperature of link 66. Depending upon the heat transfer characteristics of the material, liquefaction of the material may take place entirely under the influence of the external heater 22 or partly under the influence of the fusible assembly 56. In either event, as soon as assembly 56 is exposed to atmosphere, coil 68 is enabled to promptly elevate link 66 to its fusing temperature, thereby rupturing the same. By virtue of the series connection between link 66 and coil 68, the fusing of link 66 interrupts the heating action.

The form of the invention shown in Figures 6 and 7 may, if desired, embody the well and handle construction of Figures 3, 4, and 5, but is illustrated as embodying the construction of Figures 1 and 2 with the exception that the fusible link 40 is replaced by an interrupter assembly 70. Assembly 70 comprises a bimetallic element 72, which carries an insulated heater coil 74. Bimetallic element 72 also carries a moving contact 76, which normally engages a fixed contact 78. Contact 78 is carried by, but insulated from, a supporting member 80, which also serves as a support for element 72. One spring-like end 82 of support 80 is laterally turned and, when the contacts 76—78 are closed, overlies the end of element 72. Heating of element 72, of course, causes it to warp downwardly as viewed in the figures and separate the contacts, enabling the spring-like portion 82 to move into blocking relation to element 72 and prevent a reclosure of the contacts 76—78.

One end of heater 74 is connected to terminal 44, and the other end thereof is connected to moving contact 76, either directly or through the body of the bimetallic element 72. The stationary contact 78 is continuously connected to the remaining terminal 42. With this relation, the heater circuit includes in series the primary heater 22, heating coil 74, and contacts 76—78.

As before, the interrupter assembly 70 is embedded in the cake 20 as an incident to the initial

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formation thereof. In such embedding process, it is, of course, preferred that the crystals of vaporizable material entirely surround and engage all surface areas of the assembly 70.

In operation, assuming the cake 20 is in place in the vaporizer, and the unit is plugged into a source of supply, the main heater 22 acts to heat the cake 20 as a whole and liquefies the same. The heating current also flows through the bimetallic heater 74, enabling it to heat the bimetallic element 72. Depending upon the heat transfer characteristics of the vaporizable cake 20, it may extract heat from the interrupter assembly 70 rapidly enough to maintain it below the melting point of the vaporizable material, in which event the liquefaction of the latter takes place from the outside in towards the center. In other instances, assembly 70 may ultimately reach a temperature above the melting point of the vaporizable material, before the latter has become entirely liquefied. Even in such instances, several factors contribute to prevent the opening of contacts 76—78 until the material has been vaporized to a point at which the level of the liquid in the container is below the level of assembly 70.

In the first place, at least until the material immediately surrounding bimetallic element 72 has liquefied, the material itself is effective to mechanically restrain bimetallic element 72 and prevent it from separating the contacts 76—78. In the second place, the heat capacity of element 72, the heating effect of heater 74, and the heating effect of the main heater 22, may be so related to the heat capacity of the cake 20 as to insure that liquefaction of the cake has taken place before element 72 has absorbed enough heat from heater 74 to open the contacts. Finally, and of perhaps controlling importance, the temperature at which bimetallic element 72 opens contacts 76—78 is set well above the boiling point of the liquid vaporizable material. Consequently, contacts 76—78 remain closed until the vaporizing action has been completed, or substantially so. When this stage is reached, assembly 70 becomes exposed to atmosphere, enabling heater 74 to rather promptly bring bimetallic element 72 up to its critical temperature at which it opens its contacts 76—78 and interrupts the heating action. As aforesaid, finger portion 82 of support 80 springs into the path of element 72 when the latter opens contacts 76—78, and prevents a reclosure thereof.

Although only several embodiments of the invention have been described in detail, it will be appreciated that various further modifications in the form, number, and arrangement of the parts may be made without departing from the spirit and scope of the invention.

What is claimed is:

1. A vaporizing device comprising a container for receiving vaporizable material which is normally in solid form but which is vaporizable upon the application of heat, thermally responsive control means normally embedded in and carried by said material in heat exchange relation therewith and having a critical operating temperature, means for supplying heat to said material to vaporize it and to said element at such rate as to be normally effective to raise it to said critical operating temperature, said material having a vaporizing temperature below said critical temperature whereby said material is effective by virtue of said heat transfer relation to maintain the temperature of said control means below said critical temperature until the vaporization of said

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material has progressed to a predetermined degree, said control means being effective when it reaches said critical temperature for reducing the heat supplied by said heat supplying means, and means forming a releasable heat energy transfer connection between said control means and said supply means whereby said control means may be removed prior to the placing of a fresh charge of new material into said container.

2. The structure of claim 1 wherein said thermally responsive control means is positioned in the body of said material in direct conductive heat transfer relation thereto.

3. The structure of claim 1 wherein said heat supplying means includes an electric heating element for supplying vaporizing heat to said material and said control means includes an electrically conductive element connected to receive heating current concurrently with said heating element, said control means effecting said control by interrupting said flow of heating current.

4. The structure of claim 1 wherein said control means includes a fusible link disposed to receive heating current, and means rendering the fusing of said link effective to reduce the heat supplied by said heat supplying means.

5. The structure of claim 1 wherein said control means includes a fusible link and an electrically conductive heater therefor disposed to receive heating current, and means rendering the fusing of said link effective to reduce the heat supplied by said heat supplying means.

6. The structure of claim 1 wherein said control means includes a member having a portion which moves in response to changes in its temperature, and a heater therefor, and means rendering movement of said portion effective to reduce the heat supplied by said heat supplying means.

7. The structure of claim 1 wherein said control means includes a member having a portion which moves in response to changes in its temperature, circuit controlling contact means actuable by said movement of said portion, an electrically conductive heater for said member, and means rendering the energization of said heat supplying means and said heater subject to said contact means.

8. The structure of claim 1 wherein said control means includes a member having a portion which moves in response to changes in its temperature, circuit controlling contact means actuable from a first circuit controlling position to another by said movement of said portion, an electrically conductive heater for said member, means rendering the energization of said heat supplying means and said heater subject to said actuation of said contact means, and means effective after a said actuation for preventing a return of said contact means to said first position.

9. A vaporizing device comprising a container adapted to receive a body of vaporizable material normally in solid form, a thermally responsive electrically conductive control means carried by and positioned within said material and in direct conductive heat transfer relation to said material, electric heating means carried by said container and arranged to supply heat to said material, means adapting said heating means and said control means for connection to a source of current so as to concurrently receive heating current at rates sufficient, respectively, to vaporize said material and, normally, to actuate said control means, said adapting means including a partable connection one portion whereof

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being carried by said container and another portion whereof being carried by said material, said control means when actuated being effective to interrupt said flow of heating current, said material having a vaporizing temperature below said critical temperature whereby said material is effective by virtue of said heat transfer relation to maintain the temperature of said control means sufficiently low to prevent said actuation thereof until the vaporization of said material has progressed to a predetermined degree.

10. The structure of claim 9 wherein said control means comprises a fusible link, fusing whereof interrupts said flow of heating current.

11. The structure of claim 9 wherein said control means comprises a fusible link and an electrically conductive heater therefor, fusion of said link serving to interrupt the flow of current to said heater and said heating means.

12. The structure of claim 9 wherein said control means comprises a member having a portion which moves in response to changes in its temperature, an electrically conductive heater therefor, and means responsive to movement of said portion for interrupting the flow of current to said heater and said heating means.

13. The structure of claim 9 wherein said control means comprises a member having a portion which moves in response to changes in its temperature, an electrically conductive heater therefor, means responsive to movement of said portion for interrupting the flow of current to said heater and said heating means, and means forming part of said control means for maintaining said interruption after cessation of the flow of heating current.

14. A vaporizing device comprising a container for receiving a body of vaporizable material, which body carries a thermally responsive circuit controlling element and terminals leading thereto, said device comprising an electric heating element, partable spaced terminals for electrical connection to said first-mentioned terminals when the body of the material is positioned in the container, one of said terminals being carried by said material and another of said terminals being carried by said container, and circuit means adapting said electric heating element for connection to a source of power in series with said terminals.

15. As an article of manufacture, a body of vaporizable material, a thermally responsive circuit controlling device carried by said body for and connectible between associated supply terminals of an associated vaporizing device.

16. The article of claim 15 wherein said circuit controlling element comprises a fusible link and an electric heater therefor and connected to receive current through said link.

17. The article of claim 15 wherein said circuit controlling element includes a thermally responsive member having a portion which moves in response to changes in temperature, contact means controlled by said movement, and an electric heater for said member connected to receive current under control of said contact means.

18. The article of claim 15 wherein said circuit controlling element includes a thermally responsive member having a portion which moves in response to changes in temperature, contact means controlled by said movement, an electric heater for said member connected to receive current under control of said contact means, and

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means for maintaining said circuit in interrupted condition, after interruption thereof.

19. As an article of manufacture, a body of vaporizable material disposed to be positioned in a container and to receive vaporizing heat therefrom, a thermally responsive control element carried by said body in direct conductive heat transfer relation thereto, and connecting means for said element carried by said body and having exposed portions adapted to make an operative connection with associatable means carried by said container.

20. As an article of manufacture, a body of normally solid vaporizable material, a thermally responsive circuit controlling device carried within said body, terminals carried by said body and connectible with associated supply terminals of an associated vaporizing device.

21. A vaporizing device comprising a container for receiving a vaporizable material which is normally in solid form but which is vaporizable at a temperature below a critical temperature upon the application of heat, said container having a heater associated therewith for supplying heat to said material, a control circuit for said heater and having control terminals facing the interior of said container for association with thermal responsive control means originally embedded in said material and releasably contactable with said terminals upon the placing of said material in said container, means for supplying a source of energy to said terminals whereby said thermal means is heated independently of said heater at a rate such that when said thermal means is in heat exchange relation with said material said thermal means is maintained below said critical temperature and maintains said heater energized, said rate being such that when said thermal means is not in heat exchange relation with said material said thermal means becomes elevated above said critical temperature to de-energize said heater.

22. The combination of claim 21 in which said terminals are female and are located adjacent the bottom wall of said container.

23. The combination of claim 21 in which the bottom wall of said container is provided with a recess and said terminals are in said recess.

24. A vaporizing device comprising, an upwardly facing cup-shaped container having a bottom wall and adapted to receive a body of normally solid material vaporizable upon application of heat thereto below a critical temperature, a pair of electrical terminals carried by said container, said body having a bottom surface, heating means supplying heat to said body, a thermal responsive control means within said body adjacent said bottom surface and controlling the energization of said heating means, contacts carried by said body and connectible with said first-named terminals with said body in said container, said heating means supplying heat to said body at such a rate that said material will vaporize below said critical temperature and thereby maintain the temperature of said control means below said critical temperature, said heating means rate being sufficiently great whereby when said material is substantially vaporized the temperature of said control means will increase to said critical temperature, said control means acting at said critical temperature to terminate the heating effect of said heating means.

25. The combination of claim 24 in which said heating means is electrically energized.

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26. A vaporizing device comprising, an upwardly facing cup-shaped container having a bottom wall and adapted to receive a body of normally solid material vaporizable upon application of heat thereto below a critical temperature, a pair of electrical terminals carried by said container and facing the interior of said container bottom wall, said body having a bottom surface adapted to rest on said bottom wall, heating means supplying heat to said body, a thermal responsive control means within said body adjacent said bottom surface and controlling the energization of said heating means, contacts carried by said body bottom surface and connectible with said first-named terminals upon insertion of said body in said container, said heating means supplying heat to said body at such a rate that said material will vaporize below said critical temperature and thereby maintain the temperature of said control means below said critical temperature, said heating means rate being sufficiently great whereby when said material is substantially vaporized the temperature of said control means will increase to said critical temperature, said control means acting

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at said critical temperature to terminate the heating effect of said heating means.

LEONARD BODDY.

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