Oct. 28, 1952 H. R. STAGNER 2,615,215

VAPORIZING APPARATUS

Filed Oct. 5, 1946 4 Sheets-Sheet 1

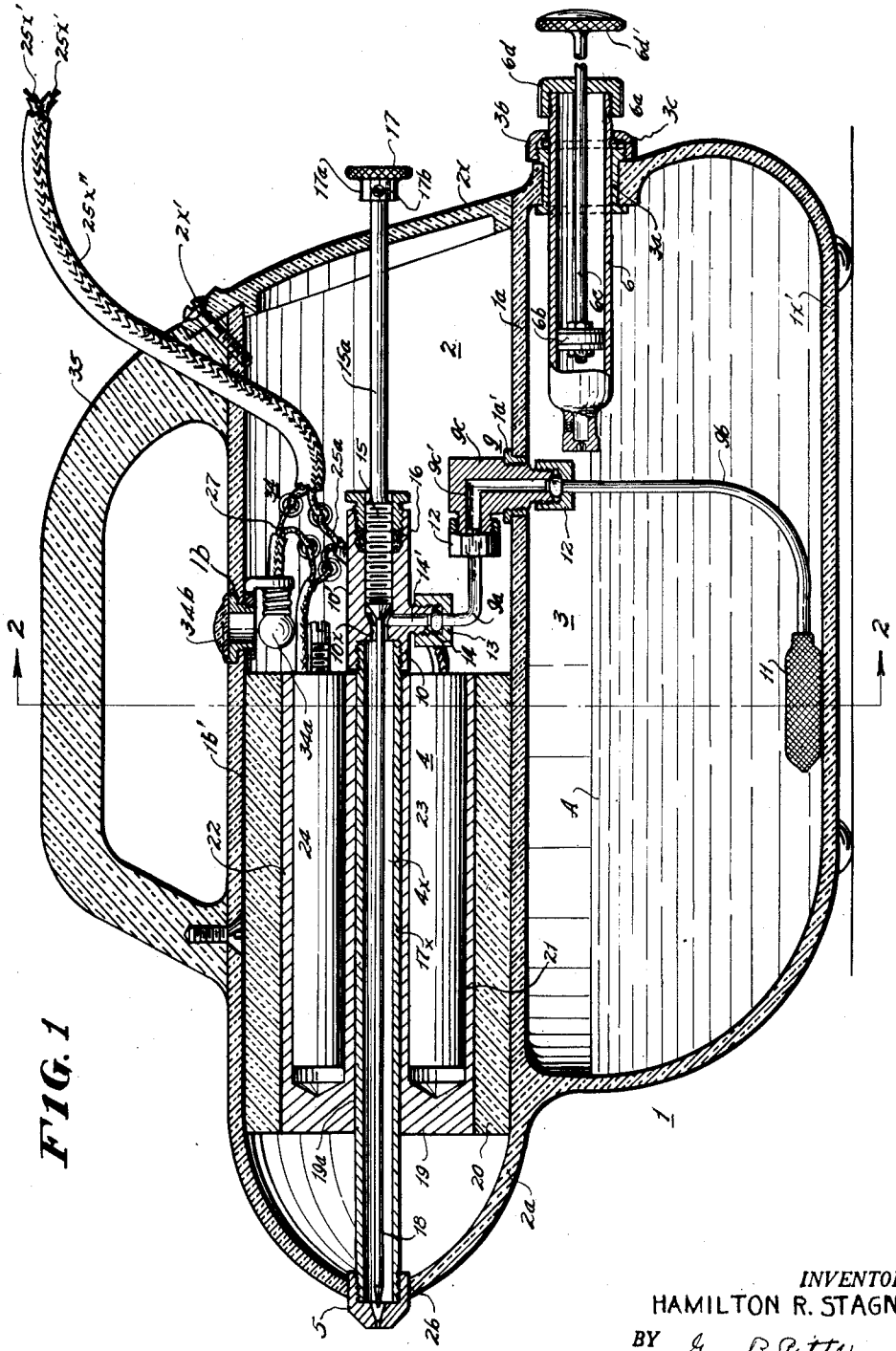


FIG. 1

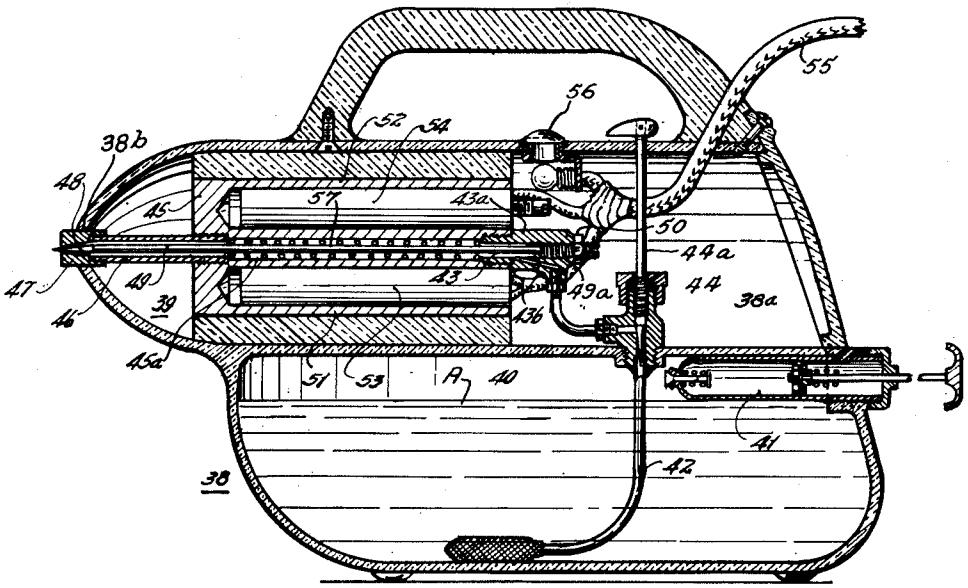
INVENTOR.
HAMILTON R. STAGNER.
BY Geo. B. Pitts
Attorney

Oct. 28, 1952 H. R. STAGNER 2,615,215

VAPORIZING APPARATUS

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FIG. 9



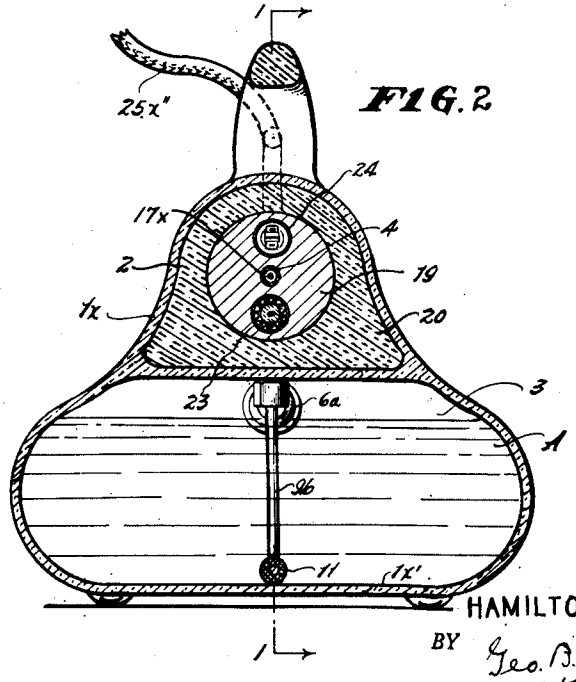


FIG. 2

INVENTOR.
HAMILTON R. STAGNER.
BY Geo. B. Pitts
attorney

Oct. 28, 1952 H. R. STAGNER 2,615,215

VAPORIZING APPARATUS

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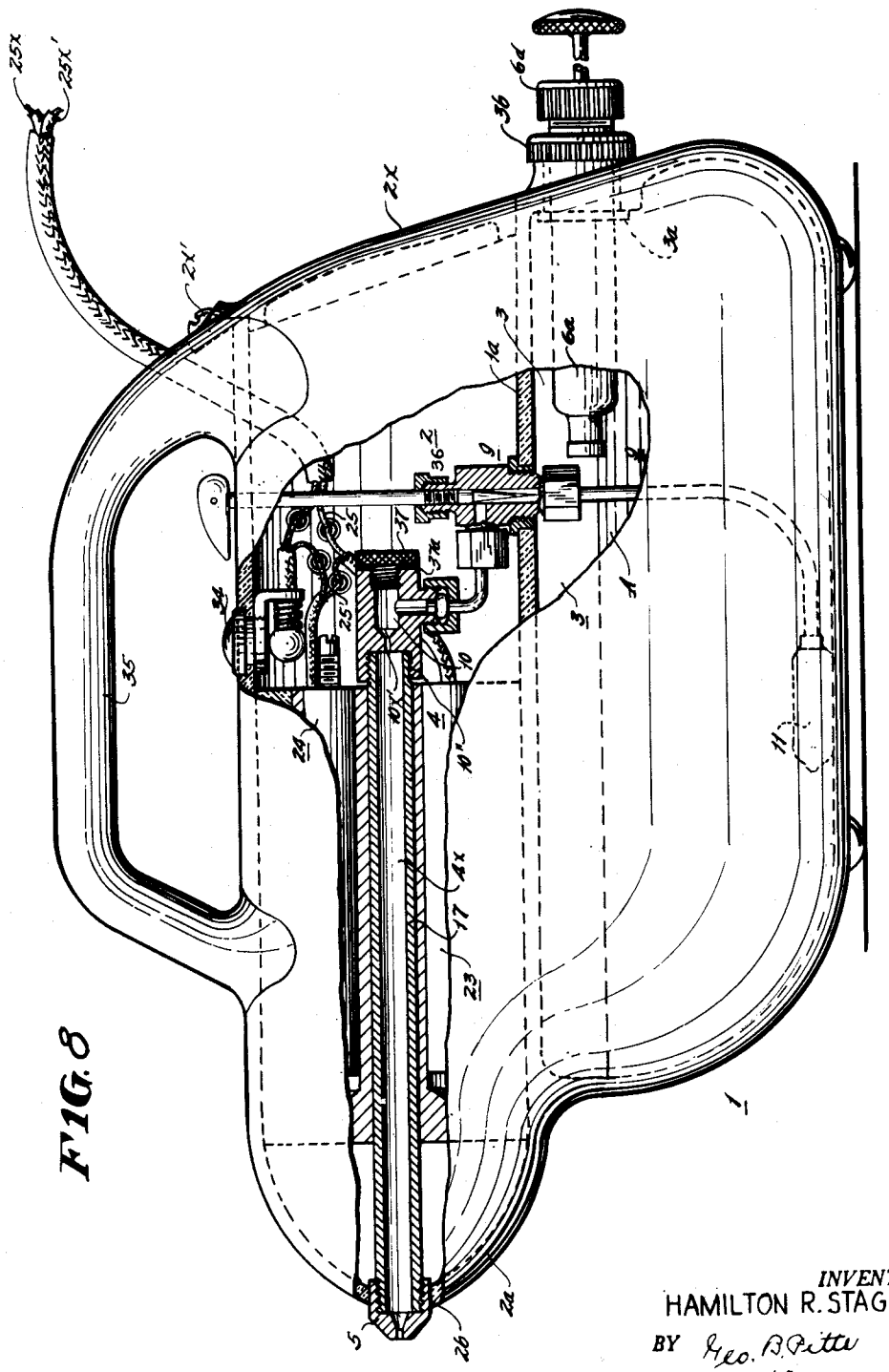


FIG. 8

INVENTOR.
HAMILTON R. STAGNER.
BY Geo. B. Pitts
Attorney

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VAPORIZING APPARATUS

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FIG. 4

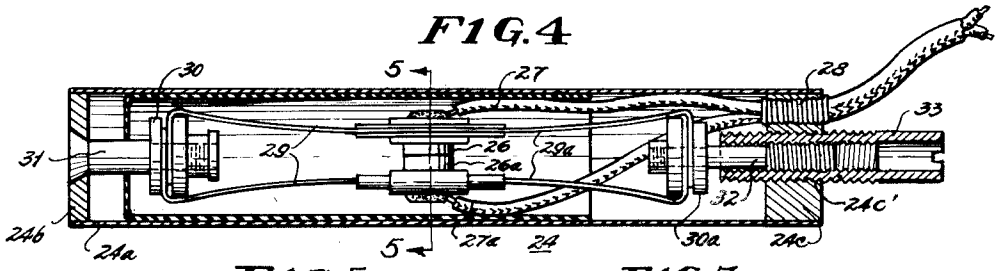


FIG. 5

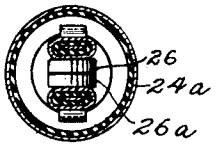


FIG. 7

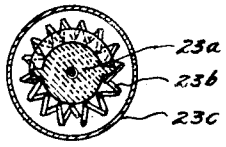


FIG. 6

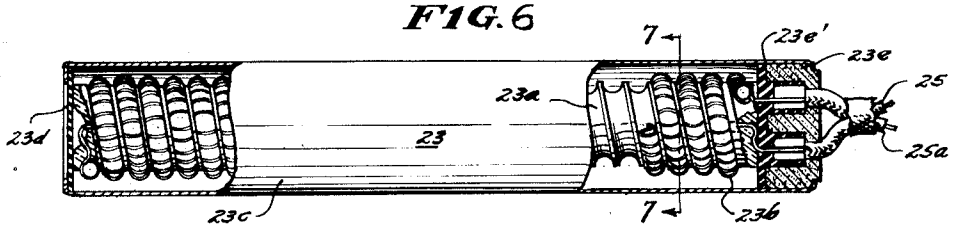
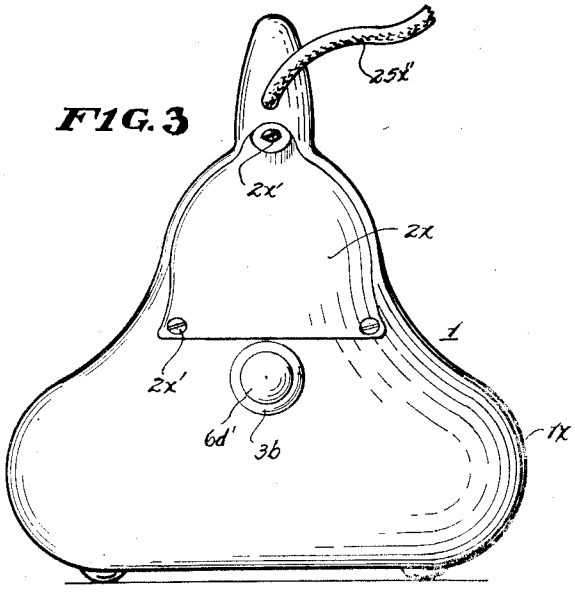


FIG. 3



INVENTOR.
HAMILTON R. STAGNER
BY Geo. B. Pitts
Attorney

Patented Oct. 28, 1952

2,615,215

UNITED STATES PATENT OFFICE

2,615,215

VAPORIZING APPARATUS

Hamilton R. Stagner, Cleveland, Ohio

Application October 5, 1946, Serial No. 701,453

14 Claims. (Cl. 21—119)

1

This invention relates to a portable apparatus for vaporizing various kinds of liquid and discharging the vapor therefrom for the purpose of providing a diffused atmosphere in a room, hall or other area and/or treating various kinds of materials. For example, if the liquid is an insecticide, the vapor may be applied on or over plants, shrubbery and the like, surfaces, and various materials or discharged in a confined area for the purpose of killing rodent and insect life; if the liquid is a disinfectant, the vapor may be applied to various kinds of materials or discharged into a confined area to neutralize abnormal conditions on such materials or in the confined area; or if the liquid is of a medicinal character, the vapor may be discharged into a room or other area, whereby a person therein may inhale the diffused medicated atmosphere to take advantage of the medicinal properties of the liquid.

One object of the invention is to provide an improved device of this character having a chamber for the liquid to be vaporized, a vaporizing chamber, into which the liquid is supplied, a nozzle or outlet for the discharge of the vapor and means for vaporizing the liquid supplied to the vaporizing chamber.

Another object of the invention is to provide an improved portable device for vaporizing a liquid and discharging it in the form of dry vapor into a room or confined area, for diffusion in the atmosphere therein, whereby certain beneficial or advantageous results may be attained dependent upon the nature and properties of the liquid.

Another object of the invention is to provide an improved device of this character containing a supply of liquid, means for vaporizing the liquid and means for automatically controlling the heating means.

Another object of the invention is to provide an improved device of this character containing a supply of liquid, means for vaporizing the liquid, and pressure applying means for supplying the liquid to the vaporizing means.

A further object of the invention is to provide an improved portable device containing liquid to be vaporized and having means for vaporizing the liquid and an outlet for the vapor of simple compact construction, whereby the device may be readily carried and operated.

Another object of the invention is to provide an improved apparatus of this character containing a quantity of liquid and means for vaporizing the liquid to produce a vapor devoid of moisture, which may be discharged in a room or other

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area, to treat conditions therein, without danger of spoiling various fabric and other materials in the room or other area.

Other objects of the invention will be apparent to those skilled in the art to which my invention relates from the following description taken in connection with the accompanying drawings, wherein

Fig. 1 is a sectional view of an apparatus embodying my invention, on the line 1—1 of Fig. 2.

Fig. 2 is a section on the line 2—2 of Fig. 1.

Fig. 3 is a rear elevation.

Fig. 4 is a fragmentary section on the line 1—1 of Fig. 2, enlarged.

Fig. 5 is a section on the line 5—5 of Fig. 4.

Fig. 6 is an elevational view of the heating means, parts being broken away.

Fig. 7 is a section on the line 7—7 of Fig. 6.

Fig. 8 is a view substantially similar to Fig. 1, but showing a modified form of construction.

Fig. 9 is a sectional view showing another modified form of construction.

In the drawings, 1 indicates as an entirety a casing formed of suitable material and having an intermediate transverse wall 1*a* which in connection with the sides of the casing forms therewithin upper and lower chambers 2, 3, the upper chamber 2 being open at its rear end to permit access thereto and assembly therein of liquid vaporizing means indicated as an entirety at 4. The open end of the chamber 2 is provided with a cover 2*x*, which is preferably removably secured in position by a plurality of screws 2*x'* (see Fig. 3). The opposite or front end of the chamber 2 is closed by a wall 2*a*, preferably of substantially semi-spherical shape, extending outwardly beyond the adjacent end wall of the chamber 3. The wall 2*a* is formed with an axial opening 2*b* in which a nozzle 5 is removably seated. The nozzle 5 is formed with a through opening connected with the vaporizing means 4 and serves as the discharge outlet for the liquid or vapor as later set forth. The chamber 3 provides a reservoir for a suitable liquid A, which is to be discharged from the nozzle 5 or vaporized and discharged in the gaseous state therefrom. The lower portions of the side walls 1*x* of the casing 1 are extended laterally to increase the capacity of the reservoir 3, as well as to provide a relatively wide bottom wall 1*x'* to stabilize the casing 1 against displacement when positioned on a support. The reservoir 3 is filled with a quantity of the liquid A through a collar 3*a*, preferably suitably mounted in the rear wall of the casing 1, below but adjacent to the wall 1*a*. The opening through the

collar 3a is sealingly closed by the casing 6 of a pneumatic pump 6a and the mounting elements therefor; the pump 6a is removed when the reservoir 3 is to be filled with the liquid A. As shown, the outer end of the collar 3a is provided with a flange which is externally screw threaded and engaged by the threaded wall of a coupling 3b, the coupling in turn engaging a circumferential collar 3c on the pump casing 6, so that by means of a suitable gasket between the coupling 3b and collar 3c, the opening through the collar 3a is sealed to prevent escape of the liquid and air from the reservoir 3. As the lower side wall of the collar 3a may serve to determine the maximum quantity of liquid to be supplied to the reservoir 3 and provide an air space above the liquid, the collar 3a is mounted adjacent to the transverse wall 1a. The pump casing 6 encloses a suitable piston 6b provided with a rod 6c extending through the outer removable end wall 6d of the casing 6 and provided with a handle 6d', whereby the piston 6b may be manually reciprocated. The inner end wall of the casing 6 is provided with a normally closed spring operated valve arranged to close in the rearward or outward stroke of the piston 6b and open during the forward stroke thereof whereas the piston 6b is provided with a normally closed spring operated valve arranged to open in the rearward or outward stroke of the piston 6b and to close in the inward or forward stroke thereof to supply the compressed air into the reservoir 3. The above referred to valves for the pump 6 are of well known construction, for which reason they are not shown, but may be of the form shown in Fig. 9. As will be apparent, operation of the pump 6a serves to provide a pressure in the reservoir 3 on the surface of the liquid A, the effect of which is to force the latter through a conduit 9 to a supply chamber 10, which is formed in a fitting 10' and connected at its inner end by a port 10x to the vaporizing chamber 4x of the vaporizing means 4. The conduit 9 preferably extends to the bottom wall 1x' of the reservoir 3 and is provided at its intake end with a suitable screen 11.

The conduit 9 preferably consists of upper and lower sections 9a, 9b, respectively, and a fitting 9c which is formed with a through opening 9c'. The fitting 9c is provided with an externally threaded wall, which is threaded into a collar 1a' suitably mounted in the wall 1a. The opposite ends of the fitting 9c terminate in externally threaded nipples with which suitable couplings 12 are removably engaged to connect the adjacent ends of the conduit sections 9a, 9b, thereto. The outer end of the conduit section 9a is removably connected in a similar manner by a coupling 13 to a nipple 14 formed integrally with the fitting 10' and formed with a duct 14' connected to the supply chamber 10. In the embodiment shown in Fig. 1, the inner end wall of the supply chamber 10 surrounding the port 10x forms a valve seat for a valve 15, which has screw threaded engagement with the walls of the chamber 10. The valve 15 is provided with a shank 15a which extends through a suitable gland 16 at the outer end of the fitting 10' and an opening formed in the cover 2x and provided at its outer end with a collar 17 having a hub 17a detachably fixed to the shank 15a by a set screw 17b. The purpose of the valve 15 is to prevent flow of the liquid to the vaporizing chamber 4x of the vaporizing means 4 (a) while pressure is being initially established in the reservoir 3 by operation of the pump 6a or (b) in advance of the heating of this chamber to a predetermined degree of temperature, as later set forth. The fitting 10' is connected to the nozzle 5 by a hollow member 17x (formed of suitable metallic material), which forms (a) a conduit for the liquid A from the supply chamber 10 to the nozzle 5, when the liquid is to be discharged in a cold or heated condition from the latter or (b) both a conduit and the vaporizing chamber 4x for the liquid A when the latter is to be vaporized and discharged from the nozzle 5 in the gaseous phase. The opposite ends of the hollow member 17x are threadedly connected to the inner walls of suitable recesses formed in the inner ends of the nozzle 5 and fitting 10', whereby these parts are rigidly connected together.

The inner end of the valve 15 is provided with a rod 18, which extends through the hollow member 17x and terminates in a tapered end and the discharge opening in the nozzle 5 is correspondingly shaped to effect the discharge of the liquid in sprayed form.

The vaporizing means 4, in addition to the chamber 4x, consists of the following: 19 indicates an elongated heat transfer or conducting element formed of a metal having a high coefficient of heat conductivity (for example, aluminum), embedded in or surrounded by a wall of suitable insulating material 20, such as asbestos. The insulating material 20 is preferably molded to fit the outer wall of the element 19 and the walls 1x, 1a, of the chamber 2 (see Figs. 1 and 2). The heat transfer element 19 is formed with a through opening 19a the walls of which fit the hollow member 17x from end to end thereof to insure direct contact therewith. The heat transfer element 19 is formed with inwardly extending recesses 21, 22, substantially co-extensive in length thereto and preferably diametrically related, the recess 21 serving to removably receive and support a heat generating means 23 and the recess 22 serving to removably receive and support a suitable thermostat 24 arranged to automatically control the operation of the heat generating means 23, as later set forth. As will be observed, the heat generating means 23 operates to heat the element 19 which in turn vaporizes the liquid supplied to the chamber 4x. The vapor expands and flows out through the nozzle 5. The heat generating means 23, as illustrated, is of the electrical resistance type, consisting of an elongated rod 23a formed of suitable non-conducting material, on which a suitable resistance 23b is wound (see Figs. 6 and 7) and connected to leads 25, 25a, of an electrical circuit 25'. The rod 23a is suitably mounted in and extends from end to end of a casing 23c, the side wall of which is formed of high heat conducting metal. The outer end of the casing 23c is closed by a disk 23d of suitable insulating material, whereas its opposite end is closed by a block 23e formed of ceramic material and supporting the leads 25, 25a, and provided on its inner side with insulating material 23e' through which the leads in separated relation extend and are supported out of contact with the casing 23c. The opposite ends of the casing 23c are bent inwardly over the outer faces of the disk 23d and block 23e to secure them against the opposite ends of the rod 23a to support the latter axially of the casing 23c. The casing 23c is of a size to snugly fit the walls of the recess 21 to insure contact therewith and of a length to extend substantially from end to end of the recess.

The construction of the thermostat 24 chosen for illustrative purposes consists of the following; 24a indicates a shell formed of relatively thin metal, adapted to expand endwise under the influence of heat, sealingly closed at its outer end by a plate 24b and sealingly closed at its inner end by a fitting 24c. 26, 26a, indicate a pair of contacts, within the shell 24a and connected to leads 27, 27a, which extend through a coil 28 for connection in the circuit 25'. The contacts 26, 26a, are normally in engagement to close the circuit 25', but are separated, due to expansion of the shell 24a, to open the circuit, as later set forth. The contacts 26, 26a, are supported on the outer ends of pairs of arms 29, 29a, respectively, which in turn are suitably fixed at their inner ends to abutments 30, 30a, respectively. The abutment 30 is suitably mounted on and secured to a pin 31 fixedly supported in the plate 24b, whereas the abutment 30a is suitably mounted on and secured to a rod 32 extending into and having screw threaded connection with the inner wall of a hollow screw 33 for adjustment relative thereto, the screw 33 in turn extending through and having threaded connection with an opening 24c', formed in the fitting 24c, whereby the screw 33 may be adjusted endwise in the latter. The supporting arms 29, 29a, are formed of resilient metal and each arm of one pair and the corresponding arm of the other pair support one of the contacts 26, 26a. Also, it will be observed that the arms of each pair converge toward their outer ends, so that by adjusting the abutment 30a relative to the abutment 30, the contacts 26, 26a, will be maintained in yielding contact, but upon expansion of the shell 24a, the abutment 30a will move toward the right (as viewed in Fig. 4) relative to the abutment 30, the effect of which is to swing the arms outwardly and disengage the contacts one from the other, to open the circuit 25'. By adjustment of the abutment 30a the spring pressure engagement between the contacts 26, 26a, can be increased or decreased with respect to the endwise expansion of the shell 24a in response to the heating of the heat transfer element 19 to a predetermined degree of temperature, dependent upon the kind of liquid A employed. Where a relatively low temperature is required, the relative adjustment of the abutments 30, 30a, will be such as to effect disengagement of the contacts upon slight expansion of the shell 24a. Where a higher temperature is required, the abutment 30a will be set to maintain the contacts under a higher degree of spring tension, so that the shell 24a is required to expand a greater distance in order to effect disengagement of the contacts 26, 26a. By reason of the adjustments for the abutment 30a, the operation of the contacts 26, 26a, to open and close the circuit 25' in response to the expansion of the shell 24a, may be controlled within a relatively small range of temperature variation. The lead 25a of the circuit 25' is connected to one supply line 25x, the lead 25 is connected to lead 27a and lead 27 is connected to the other supply line 25x' to connect the resistance 23b and contacts 26, 26a, in series; accordingly, when the heat transfer element has been heated to the degree of temperature at which the thermostat 24 is set, the contacts 26, 26a, will automatically disengage to open the circuit 25' and hence shut off the supply of heat and upon cooling of the element 19 to a degree of temperature below the thermostat setting, the contacts will automatically engage to close the circuit 25' and thus supply heat to the element 19.

34 indicates an electrically operated signalling means for indicating to the operative whether the circuit 25' is closed or open. The signalling means 34 consist of a light bulb 34a connected in series in the circuit 25' and related to a suitable lens 34b mounted in an opening 1b formed in the top wall 1b' of the casing 1. Where the liquid A is to be discharged in heated condition or is to be vaporized and then discharged in a gaseous state, the signalling means 34, upon going out of the bulb 34a, due to the operation of the thermostat 24, indicates to the operative that the heat transfer element 19 and hollow member 17x have been heated to the predetermined degree for which the thermostat 24 was set, so that the valve 15 may be opened and the liquid supplied to the member 17x; thereafter during discharge of the liquid or vapor, the bulb 34a will flash on and off due to automatic operation of the thermostat. The cable 25x'' carrying the supply lines 25x, 25x', is provided at its outer end with a suitable plug (not shown) having terminals to which the supply lines 25x, 25x', are connected and adapted to engage an outlet, whereby current is supplied to the circuit 25'.

Operation: where the liquid A is to be discharged from the nozzle 5 at the room or existing temperature, the valve 15 is closed and the pump 6a is operated to provide pressure on the surface of the liquid A. The valve 15 is then opened to permit flow of the liquid through the conduit 9, chamber 10 and hollow member 17x for discharge from the nozzle 5. If for any reason it is desirable to discharge the liquid in a heated condition, the thermostat 24 is set for operation at the desired degree of temperature, the valve 15 is closed and the circuit 25' is supplied with current to heat the element 19 and wall of the hollow member 17. Upon operation of the thermostat 24 (that is, disengagement of the contacts 26, 26a, which operation will be indicated by the going out of the light bulb 34a), the valve 15 is opened and spraying of the liquid takes place, the liquid being heated as it flows through the member 17. As the spraying operation takes place, the thermostat 24 will automatically close and open the circuit 25' to control the supply of heat to the element 19, so that all portions of the liquid flowing through the member 17 will be heated to the predetermined degree of temperature.

Where the liquid A is to be vaporized and discharged in the gaseous phase, the thermostat 24 is set to operate at that degree of temperature, which, dependent upon the kind of liquid employed, will effect vaporization thereof when supplied from the chamber 10 into the vaporizing chamber 4x, the valve 15 is closed, current is supplied to the circuit 25' and pressure is provided on the surface of the liquid A, forcing the latter into the chamber 10, and upon operation of the thermostat 24, indicated by the lighted bulb 34a going out, the valve 15 is opened to permit flow of the liquid into the vaporizing chamber 4x, whereby vaporization of the liquid takes place and the vapor is discharged from the nozzle 5.

In operating the disclosed apparatus, I have used a liquid insecticide having a petroleum base and when vaporized at a temperature of approximately 250 to 300 degrees F. the gaseous product, as discharged from the nozzle 5, is dry and completely devoid of moisture. Accordingly, the gaseous product may be applied to walls, any and all kinds of fabric materials and paper without

danger of damaging such materials and as the gaseous product expands and normally becomes diffused within and throughout the atmosphere in any enclosed area, it is effective to kill various kinds of rodent and insect life therein. The liquid may consist of a disinfectant which, when vaporized and discharged in a room will neutralize the abnormal conditions therein. If the liquid is a medicinal compound the generated vapor, when discharged in a room, will be diffused in and through the atmosphere therein, for inhaling by a person suffering from various abnormal nose or throat conditions.

As the casing 1 is provided with a handle 35, it may be carried from place to place and operated.

Fig. 8 illustrates a modified form of vaporizing apparatus, similar to the form of construction shown in Figs. 1 to 7, inclusive, except that the fitting 9 is mounted in the wall 1*a* in a vertical plane at one side of the vaporizing means 4 and provided with a valve 36 to control the flow of the liquid A through the conduit 9 to the supply chamber 10 formed in a fitting 10''. Also, the chamber 10 is sealingly closed at its outer end by a suitable screw plug 37 tightened against a gasket 37*a* and connected at its inner end by a port 10*x*' with the vaporizing chamber 4*x*. The port 10*x*' is of a predetermined diameter (preferably .0020 of an inch) and operates to provide a continuous substantially uniform quantity of the liquid to the chamber 4*x* from the chamber 10. In practice, in using an insecticide and heating the element 19 to approximately 250 to 300 degrees F., with the reservoir filled with a quart of the insecticide and subjected to a pressure of substantially ten pounds, where the port 10*x*' is of the size above set forth, the apparatus may be continuously operated to vaporize the liquid and discharge the vapor from the nozzle 5 until the quantity of liquid in the reservoir is exhausted.

Fig. 9 illustrates another embodiment of the invention consisting of the following: 38 indicates a casing constructed similarly to the casing 1 to provide a chamber 38*a* containing means, indicated as an entirety at 39, for vaporizing the liquid A and a reservoir 40 for the liquid A. 41 indicates a suitable pneumatic pump for establishing air pressure on the surface of the liquid A in the reservoir 40 to force the liquid through a conduit 42 to a chamber 43 formed in a fitting 43*a*, the discharge end of the conduit 42 being connected to the chamber 43 by a duct 43*b*. 44 indicates a valve, interposed in the conduit 42 and mounted in the wall between the chambers 38*a* and 40, the valve element of the valve 44 having a shank 44*a* which extends upwardly through the top wall of the chamber 38*a*, whereby the valve 44 may be operated to control the flow of the liquid through the conduit 42 to the chamber 43. The vaporizing means 39 consist of the following: 45 indicates a heat transfer or conducting element formed with a through opening 45*a* forming a vaporizing chamber connected at its inner end with the supply chamber 43 and connected at its outer end by a hollow member 46 with a nozzle 47, which is seated in an opening 38*b* formed in the outer end wall of the chamber 38. The inner end of the fitting 43*a* extends into and has screw threaded connection with the inner wall of the opening 45*a*, and the opposite ends of the hollow member extend into and have screw threaded connection with the outer end of the opening 45*a* and inner end of the nozzle 47. The opening through the nozzle 47 is preferably of conical shape to provide a seat for a needle valve 48. The valve 48 is provided with a shank 49 which extends rearwardly through the hollow member 46, vaporizing chamber 45*a* and fitting 43*a*, its outer end portion being enlarged, as shown at 49*a*, and having screw threaded connection with the inner wall of the fitting 43 outwardly of the discharge port of the duct 43*b*, the enlargement 49*a* serving to close the outer end of the chamber 43 and the threaded connection thereof with the inner wall of the fitting 43*a* providing means for adjusting the valve 48. The valve 48 is fixed in its adjusted position by a nut 50 tightened on the extended end of the shank 49*a* against the adjacent end wall of the fitting 43*a*. As shown, the heat transfer element 45 is formed with diametrically related recesses 51, 52, for a heat generating means 53 and a thermostat 54, respectively, connected in series in an electrical circuit 55. 56 indicates a signalling means also connected in the circuit in series with the heat generating means 53 and thermostat 54. The construction of the heat generating means 53, thermostat 54 and signalling means 56 are similar to like parts shown in Figs. 1, 4, 5, 6 and 7. 57 indicates a spiral section of wire extending from end to end of the vaporizing chamber 45*a* and adapted to circulate the liquid supplied thereto in a circuitous path to insure contact of all portions thereof with the walls of the chamber. The embodiment shown in Fig. 9 is operated to discharge the liquid A in a gaseous state substantially similar to the manner of operating the apparatuses shown in Figs. 1 and 8.

To those skilled in the art to which my invention relates many changes in construction and widely different embodiments and applications of the invention will be apparent without departing from the spirit and scope of the invention. My disclosures and the description herein are purely illustrative and are not intended to be in any sense limiting.

What I claim is:

1. An apparatus of the class described comprising a closed chamber adapted to contain a liquid and having a filling opening, means for closing said filling opening, an enclosure mounted above the top wall of said chamber, an elongated metallic heat transfer element, non-heat conducting material surrounding said element between its sides, top and bottom and the top of said chamber and the sides and top of said enclosure, means for heating said element, said element being formed with a through opening, a tube extending through said opening and fitting the walls thereof, whereby the tube walls are heated by conduction by said element, said tube forming a liquid vaporizing chamber and having an opening at its outer end for the discharge of the vapor therefrom, liquid flow connections between said liquid containing chamber and the inner end of said tube, a valve for controlling the flow of liquid through said connections, and pressure supply means for inducing flow of the liquid through said connections to said tube.

2. An apparatus as claimed in claim 1 wherein are provided means responsive to variations in the temperature of the walls of said tube for automatically controlling said heating means.

3. An apparatus of the class described, comprising a closed chamber adapted to contain a liquid and having a filling opening, means for closing said filling opening, an enclosure mounted above the top wall of said chamber, an elongated metallic heat transfer element, non-heat con-

ducting material surrounding said element between its sides, top and bottom and the top of said chamber and the sides and top of said enclosure, means for heating said element, said element being formed with a through opening, a tube extending through said opening and fitting the walls thereof, whereby the tube walls are heated by conduction by said element, said tube forming a liquid vaporizing chamber and having an opening at its outer end for the discharge of the vapor therefrom, a hollow member connected to the opposite end of said tube, the inner end wall of said member being formed with an opening providing on its inner end a valve seat, liquid flow connections between said liquid containing chamber and the side wall of said member inwardly of said valve seat, a valve element having a shank adjustably engaging the inner wall of said member to move said valve element toward and from said seat to control the supply of liquid from said member into said tube, and means for supplying pressure on the surface of the liquid in said liquid containing chamber.

4. An apparatus as claimed in claim 1 wherein said pressure supply means consists of a pump removably mounted in said filling opening.

5. An apparatus of the class described, comprising a closed chamber adapted to contain a liquid and having a filling opening, means for closing said filling opening, an enclosure mounted above the top wall of said chamber, a metallic heat transfer element, non-heat conducting material surrounding said element between its sides, top and bottom and the top of said chamber and the sides and top of said enclosure, means for heating said element, said element being formed with a through opening, a tube extending through said opening and fitting the walls thereof, whereby the tube walls are heated by conduction by said element, said tube forming a liquid vaporizing chamber, a nozzle on the outer end of said tube for the discharge of the vapor therefrom, the inner end of the nozzle opening forming a valve seat, a hollow member connected to the opposite end of said tube, the inner end wall of said member being formed with an opening providing on its inner end a separate valve seat, liquid flow connections between said liquid containing chamber and the side wall of said member inwardly of said separate valve seat, a shank extending through said member and into said tube and provided at its outer end with a valve element related to said first mentioned valve seat and intermediate its ends with a valve element related to said separate valve seat, said shank outwardly of said last mentioned valve element having adjustable connection with the inner wall of said member for operating said valve elements toward and from said seats, respectively, and pressure supply means for inducing flow of the liquid through said connections to said tube.

6. An apparatus of the class described, comprising a casing consisting of a closed chamber for a body of liquid and having a filling opening and an enclosure above said chamber, means for closing said filling opening, means within said enclosure for vaporizing the liquid, said vaporizing means consisting of a metallic member having an opening extending therethrough and forming a vaporizing chamber, the outer end of which forms a discharge for the vapor, said member being formed with an inwardly extending recess, an electrical resistance, adapted to be connected with a source of electric current supply, mounted in said recess for heating said member, liquid flow connections extending from said liquid chamber to the inner end of said vaporizing chamber, pressure applying means for inducing a flow of the liquid from said liquid chamber through said connections to said vaporizing chamber, and a valve in said connections for controlling the liquid flow therethrough.

7. An apparatus as claimed in claim 6 wherein the outer end of said vaporizing chamber is provided with a nozzle.

8. An apparatus of the class described, comprising a casing having top, bottom, side and end walls and a horizontal wall between said top and bottom walls arranged to form upper and lower chambers, said lower chamber being adapted to contain liquid and one end wall above said horizontal wall being formed with an opening, means within said upper chamber for vaporizing the liquid, said means consisting of a metallic heat transfer element formed with a through opening to provide a vaporizing chamber for the liquid, said vaporizing chamber being provided at one end with a nozzle arranged to discharge the vapor through said first mentioned opening, and means for heating said element, liquid flow connections between said lower chamber and the opposite end of said vaporizing chamber, and means within said lower chamber for inducing a flow of the liquid from said lower chamber through said liquid connections.

9. An apparatus as claimed in claim 8 wherein said heat transfer element is formed with a recess and the heating means consists of an electrical resistance mounted in said recess and adapted to be connected with a source of electric current supply.

10. An apparatus as claimed in claim 9 wherein said heat transfer element is formed with a second recess and a thermostat for operating a switch is mounted in said second recess, said switch being connected in series with said resistance and said thermostat being responsive to the rise and fall of the temperature of said heat transfer element for operating said switch to control the supply of current to said resistance.

11. An apparatus of the class described, comprising a casing having top, bottom, side and end walls and a horizontal wall between said top and bottom walls and arranged to form upper and lower chambers within said casing, said lower chamber being adapted to contain liquid, a nozzle mounted in one of said end walls above said horizontal wall, a heat transfer element mounted in said upper chamber and formed with a through opening, a hollow member extending through said opening and fitting the wall thereof and connected at its outer end to said nozzle, liquid flow connections between said lower chamber and the inner end of said hollow member, means for heating said heat transfer element, and means for inducing a flow of liquid from said lower chamber through said connections to said hollow member.

12. An apparatus of the class described, comprising a casing having top, bottom, side and end walls and a horizontal wall between said top and bottom walls and arranged to form upper and lower chambers within said casing, said lower chamber being adapted to contain liquid, a nozzle extending through one of said end walls above said horizontal wall, a metallic heat transfer element mounted in said upper chamber and formed with a through opening and separate inwardly extending recesses, a hollow member

extending through said opening and fitting the wall thereof and connected at its outer end to said nozzle, liquid flow connections between said lower chamber and the inner end of said hollow member, an electrical resistance mounted in one of said recesses, adapted to be connected to a source of electrical current supply, for heating said heat transfer element, a thermostat mounted in the other recess and connected in series with said electric resistance for controlling the supply of current thereto in response to the rise and fall of the temperature of said heat transfer element, and means for inducing flow of the liquid from said lower chamber through said liquid connections to said hollow member.

13. An apparatus of the class described, comprising a casing having top, bottom, side and end walls and a horizontal wall between said top and bottom walls and arranged to form upper and lower chambers within said casing, said lower chamber being adapted to contain liquid, a nozzle mounted in and extending through an opening formed in one of said end walls above said horizontal wall, a metallic heat transfer element mounted in said upper chamber and formed with a through opening and separate inwardly extending recesses, a hollow member

extending from the outer end of said through opening to said nozzle, liquid flow connections between said lower chamber and the inner end of said opening, an electrical resistance mounted in one of said recesses, adapted to be connected to a source of electrical current supply, for heating said heat transfer element, a thermostat mounted in the other recess and connected in series with said electric resistance for controlling the supply of current thereto in response to the rise and fall of the temperature of said heat transfer element, and means for supplying pressure on the surface of the liquid in said lower chamber.

14. An apparatus as claimed in claim 7 wherein said nozzle is provided with a valve to control the discharge of vapor therethrough.

HAMILTON R. STAGNER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
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