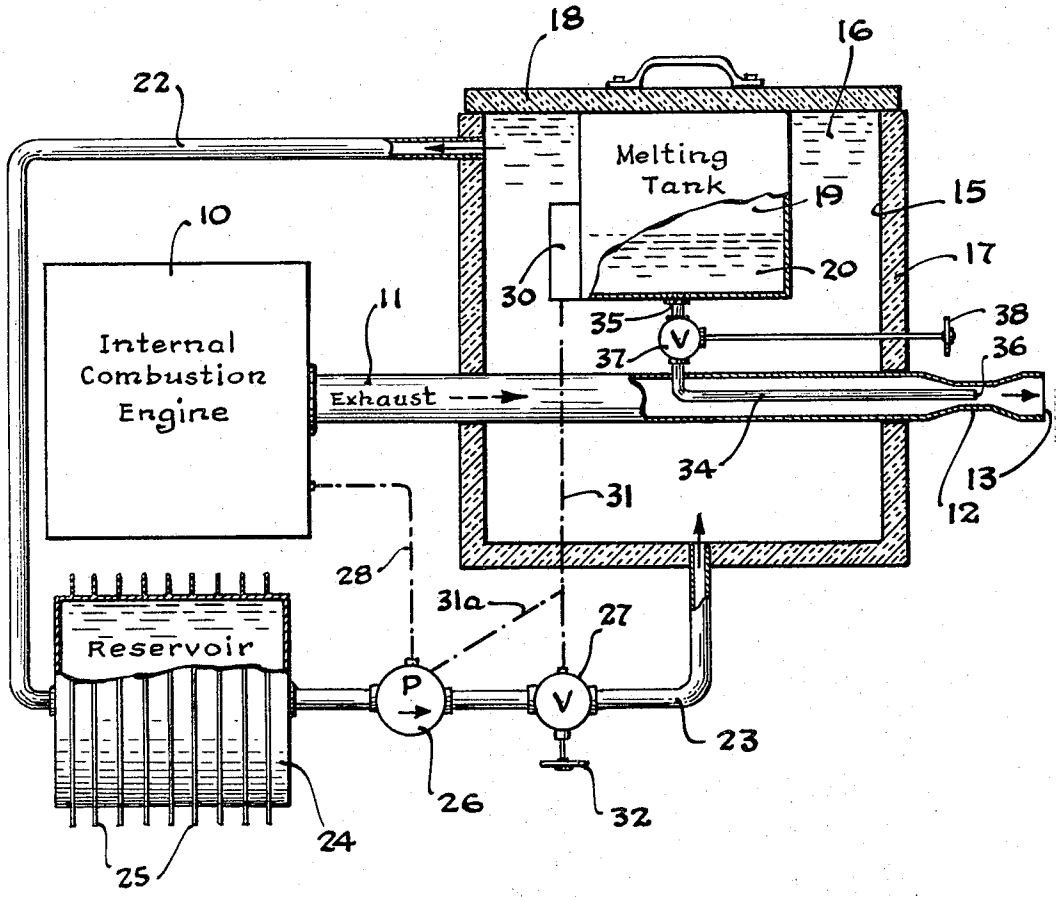
May 14, 1968 E. L. OBERTO 3,382,603

METHOD AND APPARATUS FOR VAPORIZING MATERIAL

Filed June 30, 1966

Fig.1



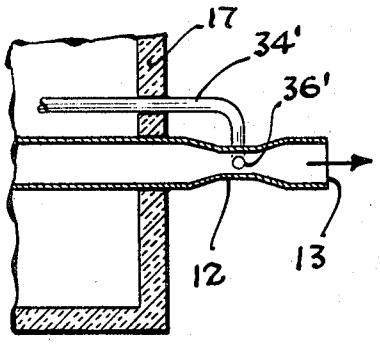


Fig.2

Inventor
Edwin L. Oberto

By Darbo, Robertson & Vandenburgh
Attorneys

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METHOD AND APPARATUS FOR VAPORIZING MATERIAL

Edwin L. Oberto, Libertyville, Ill., assignor to Burgess Vibrocrafters Inc., Grayslake, Ill., a corporation of Delaware

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20 Claims. (Cl. 43—129)

The present invention relates to a method and apparatus for producing an aerosol from a material such as an insecticide or a herbicide, and the following disclosure thereof is offered for public dissemination upon the grant of a patent therefor.

One common procedure for vaporizing insecticides, etc. is to provide a solution of the material in a carrier. The solution is then sprayed and heated to produce an aerosol. The present invention involves the liquidizing of the material by heat without the use of a carrier. Thus by dispensing with the necessity for formulation there is a cost advantage in producing insecticide, etc., dispersions by use of the present invention. Furthermore, the use of the present invention is not limited to dispensing materials that are soluble in a suitable vehicle. Also, it eliminates the dange or combustion of the vaporized vehicle, which is an oil or other volatile solvent in many presently employed formulations.

The present invention employs an internal combustion engine as a source of heat, thus it is capable of being employed in locations in which electricity is not available. Since the heat is derived from the exhaust system, there is the advantage of lack of moving parts as compared to devices driven by an internal combustion engine, which devices do work in order to obtain heat.

An important feature of the invention is the manner of controlling the heat employed for useful purposes, e.g., of controlling the temperature for melting the solid material. This is important since some materials are deleteriously affected by excess heat. While engine exhaust systems previously have been used as a source of heat there has been no adequate means in the prior art for controlling the amount of heat thus employed, to the best of my knowledge.

Further objects and advantages will be apparent from the following description taken in conjunction with the drawings in which:

FIGURE 1 is a diagrammatic illustration of an embodiment of the present invention; and

FIGURE 2 is a modification of the embodiment of FIGURE 1.

Although the following disclosure offered for public dissemination is detailed to ensure adequacy and aid understanding, this is not intended to prejudice that purpose of a patent which is to cover each new inventive concept therein no matter how others may later disguise it by variations in form or additions or further improvements. The claims at the end hereof are intended as the chief aid toward this purpose; as it is these that meet the requirement of pointing out the parts, improvements, or combinations in which the inventive concepts are found.

In the present invention heat is transferred from the engine exhaust to the material which is liquified through a heat transfer medium. The liquified material is then carried into the engine exhaust where it is further heated and vaporized. The discharge of the engine exhaust provides the force to deliver the aerosol at the area of application. To control the heat, a reservoir of the heat transfer medium is maintained with ambient air conditions

being employed to stabilize the temperature of the medium in the reservoir. A second body of the heat transfer medium is maintained in heat exchange relationship with the engine exhaust and in heat exchange relationship with the material. Cooled medium from the reservoir is added to the body of medium that is in heat exchange relationship at a rate which will maintain the temperature of the latter at the desired level. Normally this is done by means of a continuous circulation of the medium between the heat exchange body thereof and the reservoir, with temperature control being achieved by means of control of the amount of that circulation.

By use of this method one can vaporize herbicides, such as atrazine, dicamba and trifluralin from the solid state. By varying the rate of circulation of the medium one can achieve a melting temperature suitable for the material being employed, even though the materials have widely different melting ranges. For example, trifluralin has a melting temperature of 46–47 degrees centigrade, while atrazine has a melting temperature of 173–175 degrees centigrade. One can vaporize an insecticide such as heptachlor which has a melting temperature of 95–96 degrees centigrade.

FIGURE 1 illustrates an internal combustion engine **10**, having an exhaust pipe **11**. The exhaust pipe defines a venturi **12** and has a discharge opening **13**. Pipe **11** extends through a container **15** for holding a heat exchange medium **16**. The walls of container **15** are insulated, as illustrated at **17**, in order to achieve a more uniform temperature in the container and prevent heat losses therefrom. The container is provided with a removable lid **18**. Within the container is a melting tank **19** in which is received the material **20** to be vaporized. In the usual case that material will be in solid form before heat is applied in accordance with the present invention.

Two pipes, **22** and **23** respectively, connect container **15** to a reservoir **24**. Reservoir **24** is exposed to ambient air conditions so as to cool the medium **16** therein. If additional heat transfer out of the reservoir is required, means such as fins **25** are employed in the manner of a radiator. The amount of heat transfer out of reservoir **24**, and the quantity of medium **16** in reservoir **24** as compared to the amount of medium **16** in container **15**, should be such that the medium in the reservoir will have a comparatively stable temperature (substantially below the temperature of the medium in container **15**) under normal operating conditions. A pump **26** and a regulating valve **27** are provided in pipe **23** to control the flow between the reservoir and the container. As indicated by dot-dash line **28**, pump **26** is driven by engine **10**. However, in some instances the pump **26** can be dispensed with and the circulation between the reservoir and the container achieved by gravity.

A temperature responsive bulb or sensing element **30** is mounted in container **15** in heat exchange relationship with the medium **16** and with tank **19** (and thus in heat exchange relationship with the material **20**). In some embodiments the sensing element **30** will only be in temperature exchange relationship with the medium **16** and in other embodiments only with the tank (and contents) **19**. As indicated by dot-dash line **31**, the bulb is employed to automatically control the setting of valve **27** and thus the flow through pipe **23**. It is also employed to automatically control the discharge of pump **26**, as indicated by line **31***a*. As previously explained, the point is to control the circulation between the reservoir and the container so as to maintain the temperature of the medium **16** in the container **15** (and thus that of the material **20**) at a predetermined level. This level may be pre-

set by hand wheel **32** on valve **27**. In some embodiments this automatic control over the circulation, to control the temperature, is achieved solely by pump **26**, while in other embodiments it will be achieved solely by means of valve **27**.

A conduit **34** has one end **35** in communication with the interior of tank **19**, and the other end **36** positioned in the low pressure area achieved in the exhaust pipe **11** by venturi **12**. A valve **37** is mounted in conduit **34** to control the rate of flow therethrough. The setting of valve **37** is achieved by a hand wheel **38**.

The rate of flow of the medium **16** between reservoir **24** and tank **15** is adjusted so that the temperature of the medium **16** in the container **15** will be suitable for melting the material **20** in tank **19**. The melted material is drawn through pipe **34** and discharged into the exhaust of the engine at conduit end **36**. It will be noted that a portion of pipe **34** upstream of end **36** extends down through the exhaust pipe **11** in heat exchange relationship with the exhaust. The extent of this heat exchange relationship (i.e., length of pipe so exposed to additional heat) can be sufficient to supply an amount of heat to the material **20** so that the material is about at its vaporization point when it reaches end **36**. Vaporization should not occur before end **36** is reached as this will cause a vapor lock, Of course, the vaporized material is discharged out of end **13** of the exhaust pipe, which end is positioned so as to discharge the vaporized material, or aerosol, where desired.

In the illustrated embodiment the flow through conduit **34** is achieved both by gravity and by the vacuum provided by venturi **12**. In some embodiments either one or the other of these two procedures for achieving the flow of material can be employed alone. Thus, for example, venturi **12** could be eliminated and it would even be possible to have discharge end **36** of the conduit downstream from the discharge end **13** of the exhaust pipe, provided that pressure atomization is employed. The vaporized material still would be within the exhaust and would be dispersed by the engine exhaust. In the embodiments disclosed atomization is achieved through the use of the venturi.

In FIGURE 2 there is no additional heating of the material in pipe **34'** as occurs in pipe **34** in FIGURE 1. Pipe **34'** has a small opening **36'** directly at the wall of the venturi **12**.

It should be pointed out that the stabilization of the external temperature of exhaust pipe **11**, will also have some stabilizing effect upon the amount of heat of the exhaust in the pipe. It is this latter heat that is employed in the final vaporization of the liquid material.

I claim:

1. A method of producing an aerosol by using an internal combustion engine to vaporize a solid material comprising the steps of: transferring heat from the exhaust of said engine to said material to liquify the same; introducing said material after liquification into said exhaust and vaporizing the same; and releasing said exhaust toward the object to be treated.

2. The method of claim **1**, wherein after said material has been liquified and immediately prior to its introduction, additional heat is transferred to the material from said exhaust.

3. The method of claim **1**, wherein the heat is transferred from the exhaust to the material through a liquid transfer medium, and the temperature of said medium is selectively controlled.

4. The method of claim **3**, wherein the temperature control of said medium is obtained by maintaining a reservoir of said medium, cooling the medium in said reservoir by exposure to ambient conditions, maintaining a body of heated medium in heat transfer relationship between said exhaust and said material, transferring the heated medium from said body to said reservoir at a controlled rate, and replacing the transferred medium by moving cooled medium from the reservoir to the body thereof.

5. The method of claim **4**, wherein after said material has been liquified and immediately prior to its introduction, additional heat is transferred to the material from said exhaust.

6. The method of claim **4**, wherein the material is selected from the group consisting of herbicide and insecticide.

7. The method of claim **1**, wherein said material is atomized and introduced into said exhaust without first introducing additional heat into the material beyond that employed to liquify the same.

8. An apparatus for discharging a vaporized material and using an internal combustion engine and the material, said apparatus including: a heating tank for holdig said material; a liquid heat transfer medium in heat transfer relationship with said tank; an engine exhaust pipe in heat transfer relationship with said medium; and a conduit having one end positioned to pickup the liquid material from the tank and the other end positioned to discharge the material into said exhaust; whereby heat will be transferred through said medium from said exhaust to said material to heat the same, and the material conducted to said exhaust will be vaporized by said exhaust.

9. An apparatus as set forth in claim **8**, and including container means to hold a body of said medium about said tank and about said exhaust pipe; reservoir means for said medium and having two pipes connected to said container means; and flow control means connected to said reservoir means to control the flow of the medium between the reservoir means and the container means.

10. An apparatus as set forth in claim **9**, wherein said flow control means is temperature responsive.

11. An apparatus as set forth in claim **10**, wherein said flow control means has a temperature sensing member in heat transfer relationship with said medium.

12. An apparatus as set forth in claim **10**, wherein said flow control means has a temperature sensing member in heat transfer relationship with the material in said tank.

13. An apparatus as set forth in claim **9**, wherein said exhaust pipe extends through said container means.

14. An apparatus as set forth in claim **9**, wherein said flow control means includes a pump operatively connected to said engine to be driven thereby for pumping the medium between said reservoir means and said container means.

15. An apparatus as set forth in claim **14**, wherein said flow control means includes a valve.

16. An apparatus as set forth in claim **8**, wherein said exhaust pipe includes a venturi defining a relatively low pressure area in said exhaust pipe in relation to the pressure elsewhere in the pipe, said other end being positioned in said area.

17. An apparatus as set forth in claim **16**, wherein said conduit extends through the interior of said pipe upstream of said area.

18. An apparatus as set forth in claim **16**, including adjustable flow control means in said conduit.

19. An apparatus as set forth in claim **8**, wherein a portion of said conduit is in heat transfer relationship with said exhaust.

20. An apparatus as set forth in claim **8**, and including a container about said tank, said exhaust pipe extending through said container, said exhaust pipe including a venturi defining a relatively low pressure area in said pipe in relation to the pressure elsewhere in the pipe, said other end being positioned in said area, said conduit extending through the interior of said pipe upstream of said area, adjustable flow control means in said conduit, reservoir means for said medium and having two pipes connected to said container means; and flow control means connected to said reservoir means to control the flow of the medium between the reservoir means and the

container means, said flow control means including a valve and a pump operatively connected to said engine to be driven thereby for pumping the medium between said reservoir means and said container means.

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ALDRICH F. MEDBERY, *Primary Examiner.*