Nov. 4, 1969 L. MARCOUX 3,476,293

AEROSOL HEATER WITH IMPROVED CONTROL MEANS

Filed Aug. 29, 1967 2 Sheets-Sheet 1

Fig. 1.

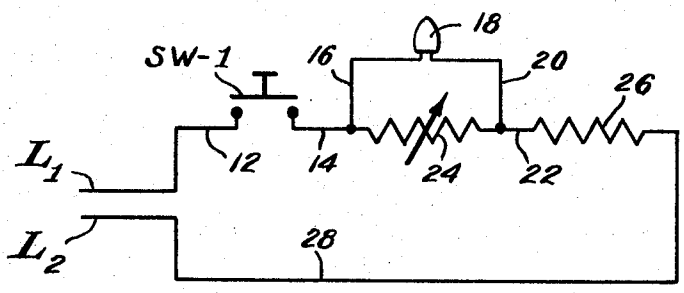

Fig. 2.

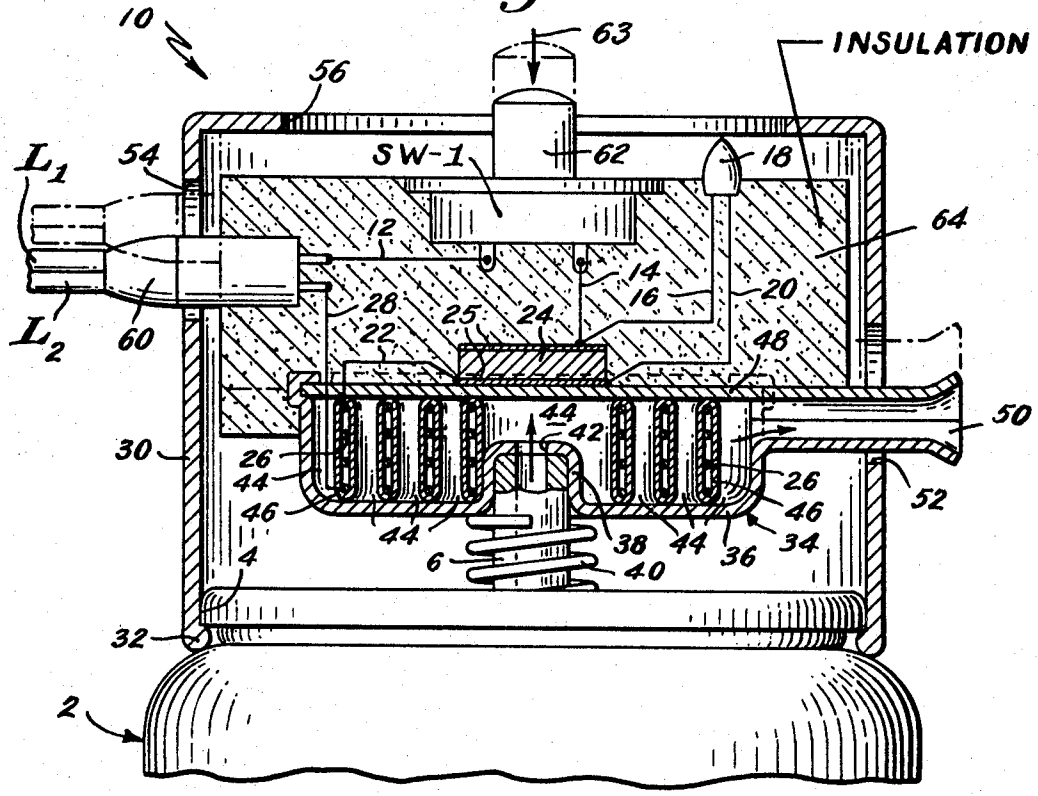

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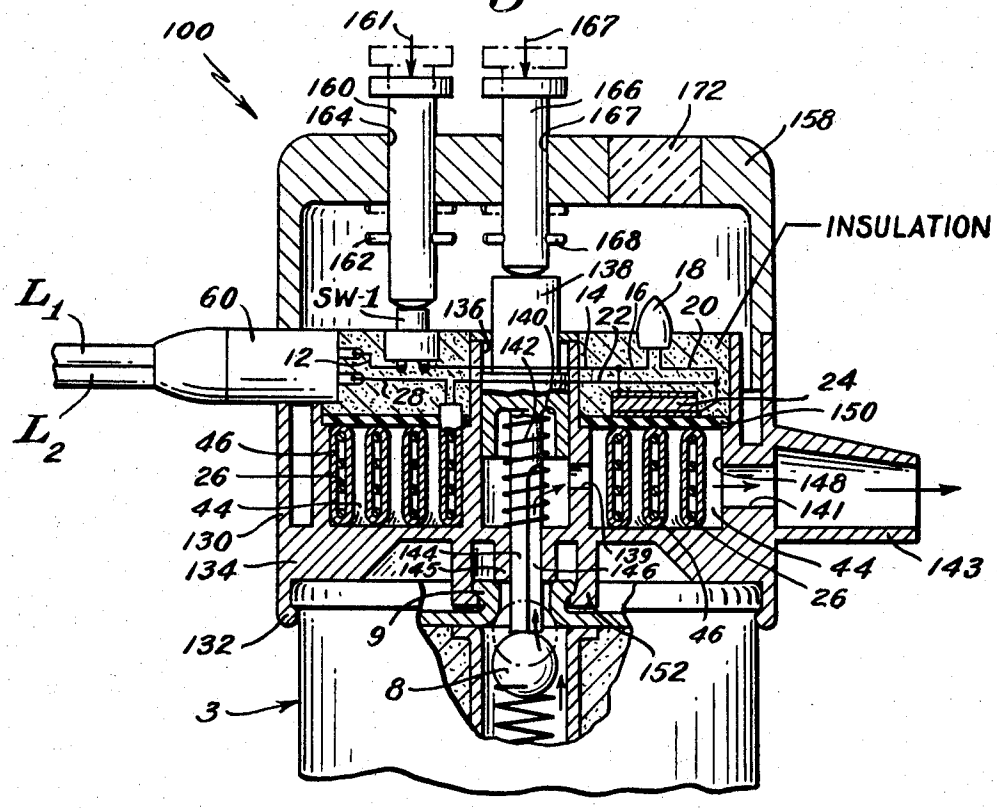
Fig. 3.



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3,476,293

AEROSOL HEATER WITH IMPROVED CONTROL MEANS

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U.S. Cl. 222—146 14 Claims

ABSTRACT OF THE DISCLOSURE

A heater-dispenser device for heating fluid materials passing therethrough is disclosed. The heater consists of a spirally wound flattened tubular sheath containing an internal resistance heater electrically insulated therefrom. A solid-state element having a temperature-resistivity curve which reflects low resistance values at relatively low temperatures and relatively small changes in resistance with increasing temperature until an anomaly point is reached at which point the resistance rapidly increases with slight increases in temperature. The element generates heat causing an increase in resistance until a thermal equilibrium is attained thereby limiting current flow. A lamp is employed as an indicator to show when the system has generated sufficient heat and is ready for dispensing. One embodiment shows a heater-dispenser which is reciprocably mounted. A second embodiment shows a stationary heater-dispenser unit with reciprocably mounted actuating means.

Background of invention

This invention relates to an improved heater-dispenser device for use with pressurized containers. More particularly , it relates to an improved device which can heat a fluid medium issuing from a pressurized package.

Pressurized containers have become widely used for packaging and dispensing fluids and fluid-like materials. It is desirable to elevate the temperature of many such materials, such as, by way of example, windshield deicing fluids for automobiles, shaving lather, certain paints and varnishes, hot fudge and similar food items, and so on.

Various prior art devices have been designed for this purpose. Generally they have been of two basic types as exemplified by the United States patent to Lannert, 2,873,-351, issued Feb. 10, 1959. This patent discloses a heat exchanger which is attachable to the outlet of an aerosol container. Fluid medium is directed through the heat exchanger as it is released from the container and is thereby heated. The heat exchanger is heated by an electric heater in one embodiment and by hot water in another embodiment. The subject matter of the instant invention relates to improvements on the first-mentioned embodiment.

Aerosol containers employ a gas, such as Freon, under pressure to force the contents thereof out of the container when the discharge valve is open. Since the containers are fabricated from relatively thin gauge materials, it is important to keep the gas pressure at a safe level. Safe maximum temperatures, e.g., 120° F., have been determined for such containers since elevating the temperature of the gas in a constant volume increases the pressure thereof. Heaters used with aerosol containers, to be safe must not cause the temperature of the container to approach these levels.

Electric heaters in prior art devices have had certain inherent limitations, to name a few, they have necessitated relatively complex, expensive constructions in order to provide adequate safety and to keep the heating device in the environs of a desired temperature by turning on and

off the heating element current by use of movable contacts. They have drawn relatively large amounts of power, line voltage variations have caused variations in heater temperature, and extra parts have been required to calibrate the heaters and regulate the temperature thereof. In copending application No. 504,944, filed Oct. 24, 1965, now Patent No. 3,338,476, issued Aug. 29, 1967 an improved heater-dispenser is disclosed and claimed comprising a solid-state heater element having a large PTC characteristic which is used not only as a controlling element but also as the primary heating element.

Using the PAC element for the dual function of heating and controlling has solved many of the prior art limitations; however, for certain applications a less expensive structure is required.

One of the drawbacks which has prevented prior art devices from becoming commercially successful for many applications is that the cost of the device has been too high in relation to the cost to the consumer of the pressurized container making it less attractive to the consumer. With this as a design parameter along with the other prior art limitations referred to above applicant has invented apparatus which meets all of the criteria mentioned above, resulting in lower cost for the PTC element and a more efficient heat transfer from the heater to the fluid in the pressurized container while still maintaining the advantages of the system contained in my copending application.

It is therefore an object of this invention to overcome the disadvantages mentioned supra and to provide a simple, inexpensive, reliable, sturdy heating device which is easy to fabricate and useful with aerosol containers.

It is another object of this invention to provide a heating device useful with aerosol containers which results in minimal heat transfer to the container.

Yet another object is to provide an aerosol dispenser-heater which has a self-regulated temperature and has inherent compensation for line voltage variations.

Another object is to provide a heater-dispenser which has a short warm up time and which is removably attachable to the outlet of the pressurized container to heat the contents as they issue therefrom.

The invention accordingly comprises the elements and combination of elements, features of constructions and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of the application of which will be indicated in the appended claims.

In the accompanying drawings in which two of the various possible embodiments of the invention are illustrated:

FIGURE 1 is a circuit diagram of the circuit employed in the embodiments shown in FIGURES 2 and 3;

FIGURE 2 is a cross-sectional view of the device constructed in accordance with the invention with an elevational view of a pressurized container shown broken away;

FIGURE 3 is a cross-sectional view of a second embodiment of the instant invention with an elevational view of a container shown partly in cross-section and broken away.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

Dimensions of certain of the parts as shown in the drawings have been modified and/or exaggerated for the purpose of clarity of illustration.

A device **10**, constructed in accordance with the invention, is illustrated in FIGURE 2. A pressurized container **2**, which holds material to be heated upon dispensing, such as shaving lather, mounts on its outlet stem **6** a heater-dispenser assembly **34**. Assembly **34** comprises cup-shaped housing **36** provided with a central recession **38** which

acts as a seat for the distal end portion of stem **6**. An aperture **42** in the recession **38** is aligned to communicate with the bore of stem **6**. Located in housing **36** is a heater formed of a thin tubular jacket **46** which closely encapsulates wire heating element **26**. Jacket **46** is formed in a spiral providing a continuous spirally shaped passage **44** through which the foam material is adapted to pass. Jacket **46** may be constructed of any good thermally conductive material, such as aluminum. A conventional electrical insulation is provided in jacket **46** to prevent short circuiting. This may be effected, for example, by anodizing the aluminum in a conventional manner or by coating the internal surface with a thin layer of a conventional polymer. Cover plate **48** is fitted on top of housing **36** and attached thereto in any convenient manner as by crimping. For reasons which will be explained below, in order to limit heat transfer from heater **26**, cover **48** may be constructed of or coated with a thermal insulating material. Electrical insulation separate cover **48** from element **24**, further described below. Housing **36** and cover **48** are formed with egress portion **50**.

Mounted on cover member **48** is a control element **24** composed of solid-state material which has as a chracteristic a large positive temperature coefficient of resistance (PTC). Polymers which can be crosslinked with carbon or other elements, such as carbon black filled, cross-linked polyethylene, e.g., No. 4510 obtained from Cabot Corporation, 125 High St., Boston, Mass., are examples of one type of material. Another class of material is certain doped ceramics, such as, barium titanate doped with lanthanum, $Ba_{.997}La_{.003}TiO_3$. Reference may be had to U.S. Patent No. 3,338,476 for more detailed information on the preparation of this material.

PTC element **24** is provided with conductive terminal layers **25** on opposite sides thereof. Layers **25** may, for example, be composed of a silver alloy coated by electroless soldering techniques known in the art.

Electrical insulation **64** which may be a conventional potting compound is conveniently employed as a support for several components of the device; viz, momentary contact switch SW–**1**, lamp **18** and plug member **60**.

Line current is conducted by a conventional two wire cord L_1, L_2. L_1 is connected to conductor **28**, thence to one end of a standard resistance heater wire **26**, the other end of heater wire **26** is connected by conductor **22** to one terminal layer **25** of the PTC control element **24**. This layer **25** is also connected to one side of lamp **18** by conductor **20**. The other layer **25** of PTC element **24** is connected to the other side of lamp **18** by conductor **16** and to one side of switch SW–**1** by conductor **14**. Lastly, the other side of switch SW-**1** is connected to L_1 by conductor **12**.

Switch SW–**1** is provided with a push button **62** which is biased upwardly by a spring (not shown). A stiffer spring **40** is mounted on stem **6** which biases assembly **34** upwardly as shown in FIGURE 2. The spring in switch SW–**1** is such that it can be depressed by application of a force on button **62** to actuate the switch without causing spring **40** to be depressed. However, upon a greater force on button **62**, the switch spring will act as a transfer member and spring **40** will be depressed to actuate the valve of the pressurized contained.

Cover member **34** encloses the heater-dispenser unit **10** and is provided with apertures **52**, **54** and **56** to allow access for plug **60**, push button **62** and egress **50** respectively. Aperture **56** is made large enough to permit lamp **18** to be seen by the operator of the device.

The operation of the device will now be explained. An initial force in the direction of arrow **63** is exerted on button **62** of switch SW–**1** depressing it from the phantom line position shown in FIGURE 2 closing the momentary contacts bridging conductors **12** and **14** as best seen in FIGURE 1. It should be noted that this initial force is of a magnitude less than that required to depress spring **40** as explained above. Current flow through PTC material **24** which in the cold state has a relatively low resistance and thence through the main heater **26** and back to L_2. Lamp **18** is preferably of the voltage sensitive avalanche type such as a neon lamp, so that initially it will not conduct at the low voltage generated across the cold PTC element. The PTC material used for effective operation of the device to permit close temperature control must have as a characteristic a large positive temperature coefficient of resistance, that is, material in which the percent change in resistance per degree change in temperature in the so-called break or anomaly point is very large. Current flowing through element **24** generates heat in the element raising its temperature until the anomaly point is reached beyond which point the resistance of element **24** rises very rapidly. The resultant voltage increase across the PTC element **24** causes the lamp to fire and also deenergizes the main heater **26**.

When light **18** conducts the user then applies sufficient force to button **62** to depress spring **40** moving the assembly **34** from the phantom line position shown in FIGURE 2 to the full line position and thereby releases the pressurized material from container **2**. The material in the container typically upon release from container **2** turns into a foamy substance containing many air bubbles and consequently is a very poor heat conductor. To optimize heat transfer from jacket **46** to the foam, the jacket is formed so that a maximum amount of surface area is exposed to the foam and the distance between the jacket walls defining passage **44** is kept relatively small so that as much of the foam as is practically possible will come in direct contact with the heat exchanger.

As an example, in one device constructed in accordance with the above, the line voltage is divided so that initially there is about 20 volts across the PTC element and about 100 volts across the heater **26**. A resulting current of 1 ampere causes 20 watts of heat generated in element **24** and about 100 watts in heater **26**. The heater, due to its substantial heat mass, quickly heats up and stores the heat. The PTC element heats up due to its own heat generation and acts as a thermal analog of heater **26**. The PTC element **24** employed has an anomaly at approximately 120° C. which is reached in about ten seconds. The PTC element **24** then takes virtually the total applied voltage, the heater voltage dropping to close to zero. Neon glow lamp **18** then turns on indicating that the system is ready to deliver hot aerosol fluid.

The system is especially useful for one shot type application since essentially all the heat generated by the heater is stored in the thermal mass of the heater with very little heat loss. The heater is thermally separated from surrounding parts consequently will lose most of its heat to the aerosol fluid when it is passed therethrough resulting in a very efficient device. As mentioned above, the PTC element **24** is designed so that it acts as a thermal analog of the heater therefore due to its own heat generating capacity it could be remotely located from the heater **26**. Preferably the PTC element is kept to a small size and is used primarily as a control device and does not contribute any substantial heat to the system.

This system also provides compensation for line voltage variation. Low voltage will cause reduced current flow which will in turn result in lower power in both element **24** and heater **26**. This will cause the PTC element **24** to heat up more slowly and consequently power will be supplied to heater **26** for a longer time so that the total heat generated will be approximately the same. High voltage will cause just the opposite reaction in element **24** so that power will be supplied to heater **26** for a shorter time and again approximately the same total heat will be generated.

It will be seen from the above that this device offers many advantages over various prior art devices. There is no standby power drain since the device is activated for only the short period required for warm up. The warm up is extremely fast. The neon glow lamp provides convenient

indication in comparison with copending application, now Patent No. 3,338,476, a lower cost PTC element design and an even more efficient heat transfer are provided.

It will be obvious to those skilled in the art that rather than using house current a rechargeable battery could be employed as the power source. The device could be connected to a charger when not in use.

If it is preferred to have the neon lamp glow until the warm up period is completed and then turn off, lamp **18** can be connected across heater **26** instead of PTC element **24**.

Turning now to a second embodiment reference may be had to FIGURE 3. Device **100** is shown comprising essentially the same heating element (wire **26** and jacket **46**) defining the same passage **44**. Therefore, the description for this portion of the device and for the electrical circuit which is the same as that for FIGURE 2 and shown in FIGURE 1 will not be repeated. In this embodiment separate actuating means are provided for the heater circuit and for the actuator of the aerosol container valve. Further, the heater-dispenser assembly is stationary relative to support **134** resulting in a more durable device.

Electrical insulation or support **134** in this embodiment is molded of a conventional polymeric material and is provided with a chamber in which the heater jacket **46** is located. Plate **150** encloses passage **44** and is constructed out of heat and electrical insulation to provide thermal separation between the PTC element **24** and heater **26** providing more accurate control capability for the element **24**. Support **134** is formed with a hub portion **145** which mounts a reciprocably movable slide **144** with an axial channel **146** therein. A bore **136** is provided in hub **145** in which motion transfer member **138** slides. A recessed annular area **140** is located in transfer member **138** to seat one end of spring **142**. The other end of spring **142** is seated adjacent hub **145** causing transfer member **138** to be upwardly biased as seen in FIGURE 3. Button **166** is mounted in bore **167** of cap **158** and is adapted to contact transfer member **138**. Stop member **168** is located on button **166** to limit the upward travel thereof.

Aperture **139** in hub **145** communicates with passage **44**. Aperture **141** located in wall **148** of support **134** communicates with passages **44** and egress **141** in wall **148**.

Button **160**, slidably mounted in bore **164** of cap **158**, is adapted to contact switch SW–1. A spring in switch SW–1 (not shown) biases button **160** upwardly, the movement of which is limited by stops **162**.

Support **134** has lip members **132** and **152** which releasably snap on to the outer rim and nozzle **9** of container **3**.

Cap **158** interfits with wall **130** of support **134** to enclose the device. Cap **158** has a transparent portion **172** to permit visual recognition of the energization of lamp **18**.

In this embodiment the user initiates the warm up by depressing button **160** in the direction of arrow **161** from the phantom line position in FIGURE 3 to the full line position. This activates switch SW–1 and the heating action occurs as in the FIGURE 2 embodiment. When lamp **18** glows, the user then depresses button **166** in the direction of arrow **167** from the phantom line position to the solid line position which causes slide **144** to move downwardly dislodging the ball valve **8** from its seat permitting the fluid to discharge through channel **146**, aperture **139** and into passage **44** wherein it is heated by contact with heat packet **46** and then is ejected through aperture **141** and out of egress **143**.

Thus it will be seen that all the objects of the invention are fulfilled.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

It is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

As many changes could be made in the above constructions without departing from the scope of the invention, it it intended that all matter contained in the above description or shown in the accompanying drawings, shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A heater-dispenser device usable with aerosol containers comprising:

(a) means defining a passage and having an ingress and an egress,

(b) a solid-state control element having a steep-sloped PTC temperature-resistivity curve,

(c) a load connected in series with said control element and in heat transfer relation to said passage defining means, and

(d) means to energize said control element and load.

2. A device according to claim **1** further including:

(e) an indicating device connected in parallel across said control element.

3. A heater-dispenser device in accordance with claim **1** in which the load is a spirally configured, flattened tubular sheath having an internal resistance wire heater therein.

4. A heater-dispenser device according to claim **2** in which the indicator device includes an avalanche-type lamp.

5. A heater-dispenser device according to claim **1** which is located in a detachable housing which is adapted to fit on top of an aerosol type container.

6. A heater-dispenser device according to claim **5** which is reciprocably mounted in the housing.

7. A heater-dispenser device according to claim **5** which is fixedly mounted on the housing and a reciprocable slide is mounted to actuate the valve of the aerosol container.

8. A device according to claim **1** in which the control element is composed of $Ba_{.997}La_{.003}TiO_3$.

9. A device according to claim **1** in which the control element is composed of a carbon black filled polymer.

10. A device according to claim **5** including a first and second spring, the second spring less stiff than the first spring, the first spring biasing the device away from the aerosol container, and the second spring biasing energizing means in an open direction.

11. Heater-dispenser apparatus comprising:

(a) a support member having an axially bored hub, a bottom wall and depending side walls with an egress therein; the hub bottom and side walls forming an annular chamber,

(b) heating means located in the chamber and defining a spiral pasasge,

(c) a cover plate enclosing the passage and forming a thermal barrier;

(d) a motion transfer member slidably mounted in the bore of the support member, and adapted upon predetermined movement thereof to actuate a valve of an associated container,

(e) means biasing the transfer member away from the the valve,

(f) a steep-sloped PTC element mounted on the support and designed to be a thermal analog of the heating means,

(g) means connecting the heating means and the PTC element in series relation to a power source, whereby when the heating means has generated and stored a predetermined amount of heat the resistance of the PTC element will rapidly increase to limit the current to the heating means.

12. Apparatus according to claim **11** in which indicator

means is provided to indicate when the apparatus is in a heated condition.

13. Apparatus according to claim 12 in which the indicating means includes a neon lamp connected across the PTC element.

14. Apparatus according to claim 11, further comprising:

(h) a cover which interfits with the support member,

(i) a first and second push button slidably mounted in the cover, the first button adapted to contact the transfer member; the second button adapted to actuate the electrical circuit.

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