United States Patent

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[54] **UNIT FOR HEATING AND DISPENSING AEROSOL PRODUCTS**
6 Claims, 15 Drawing Figs.

[52] **U.S. Cl.** **219/214,** 219/301, 219/302, 219/327, 222/146, 239/135
[51] **Int. Cl.** **B67d 5/62,** H05b 3/00
[50] **Field of Search** ..... 219/296-309, 327, 328; 222/146, 146 (HA), 146 (HE); 239/135

[56] **References Cited**

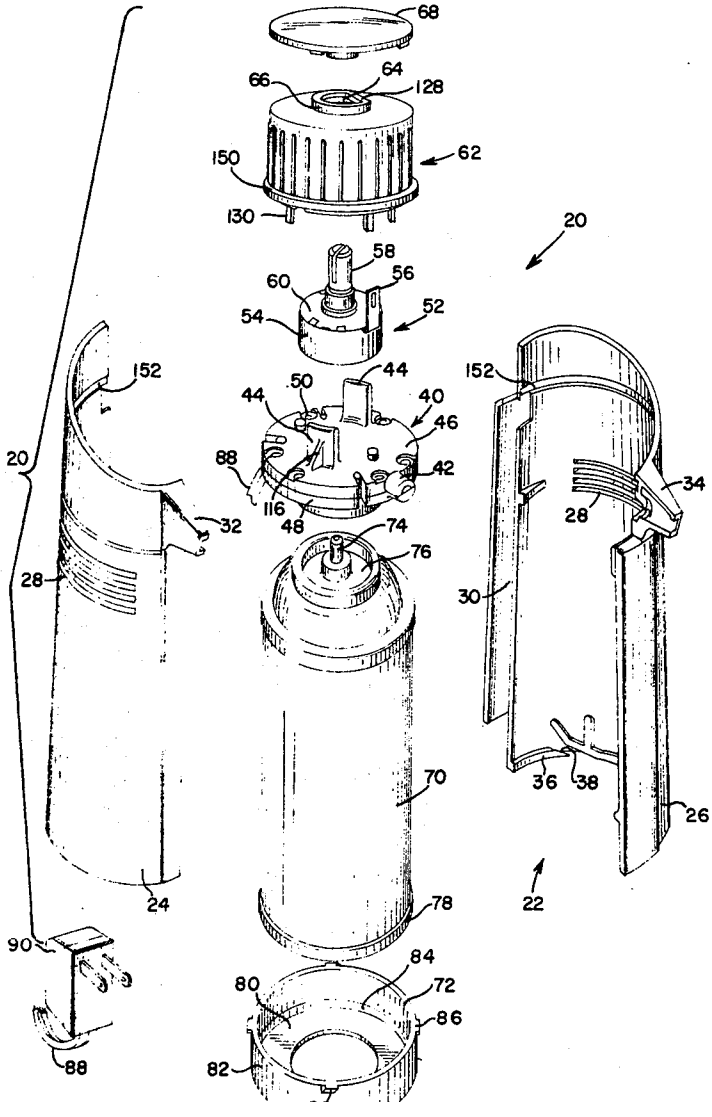
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ABSTRACT: A dispenser unit for heating and dispensing an aerosol product, comprising an exterior shell member having an opening in one end for receiving an aerosol container, and a combination product heater and dispenser including an improved nozzle, at the other end of the shell. The heater and dispenser includes a relatively massive heat exchanger having a product inlet, a product outlet, and a circuitous passage connecting the two, and is heated by heating element means of variable resistance. The heat transfer between the variable resistance heating means and the exchanger is facilitated by surrounding the heating element with an electrically insulating, heat conductive material, preferably a filled silicone grease, which is in intimate heat exchange contact with the exchanger. The product dispensed from the container is a flowable, foamable product, which includes a gaseous foaming agent therein.

The container is preferably a two-compartment container comprising an outer portion which includes a propellant having a liquid-vapor equilibrium at ambient temperatures, and a flexible, inner portion for the foamable product, so the product may be dispensed at a constant overpressure and with a constant concentration of volatile foaming agent therein.



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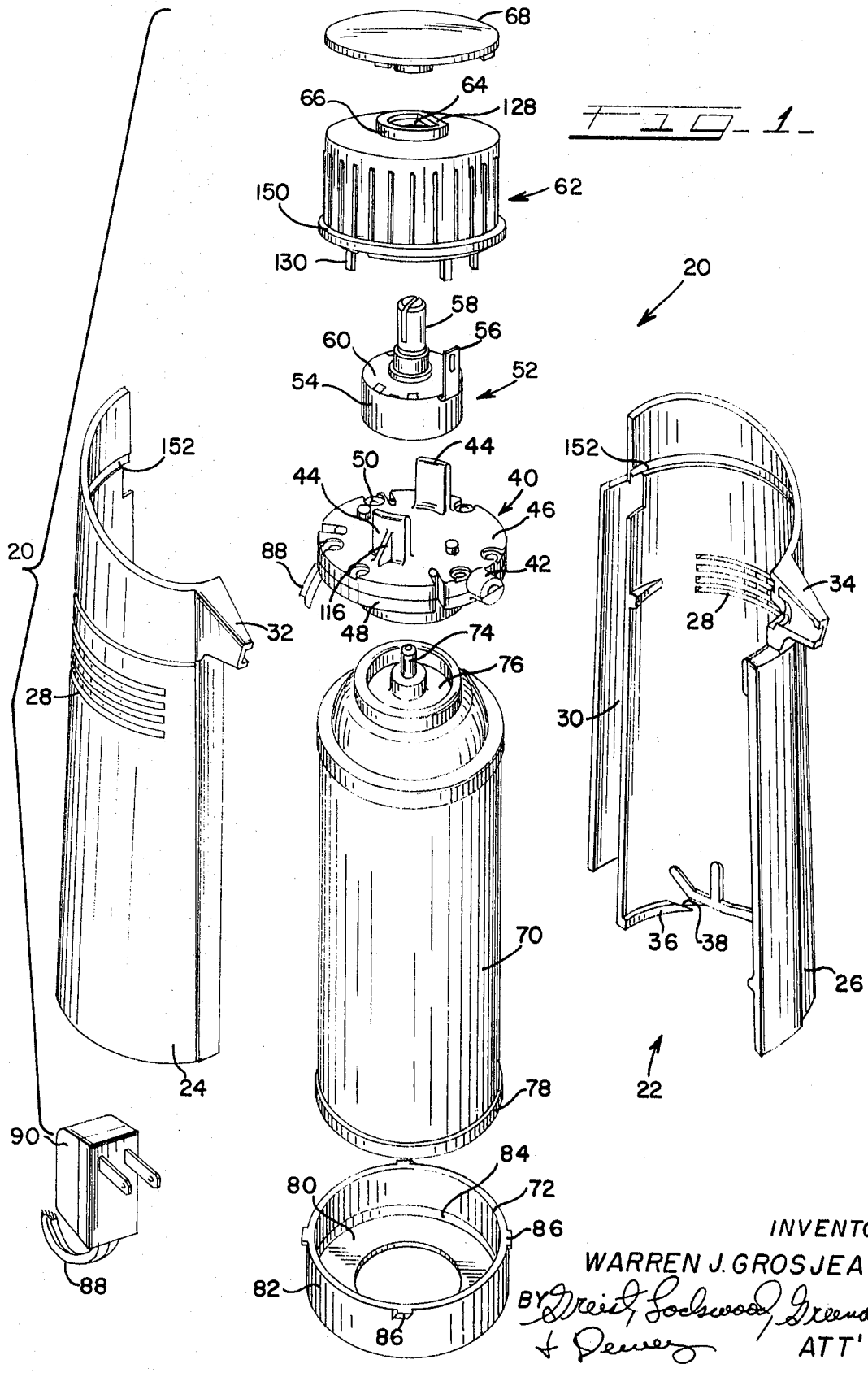


FIG. 1

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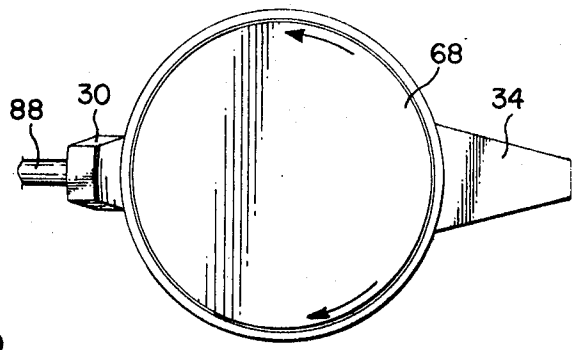
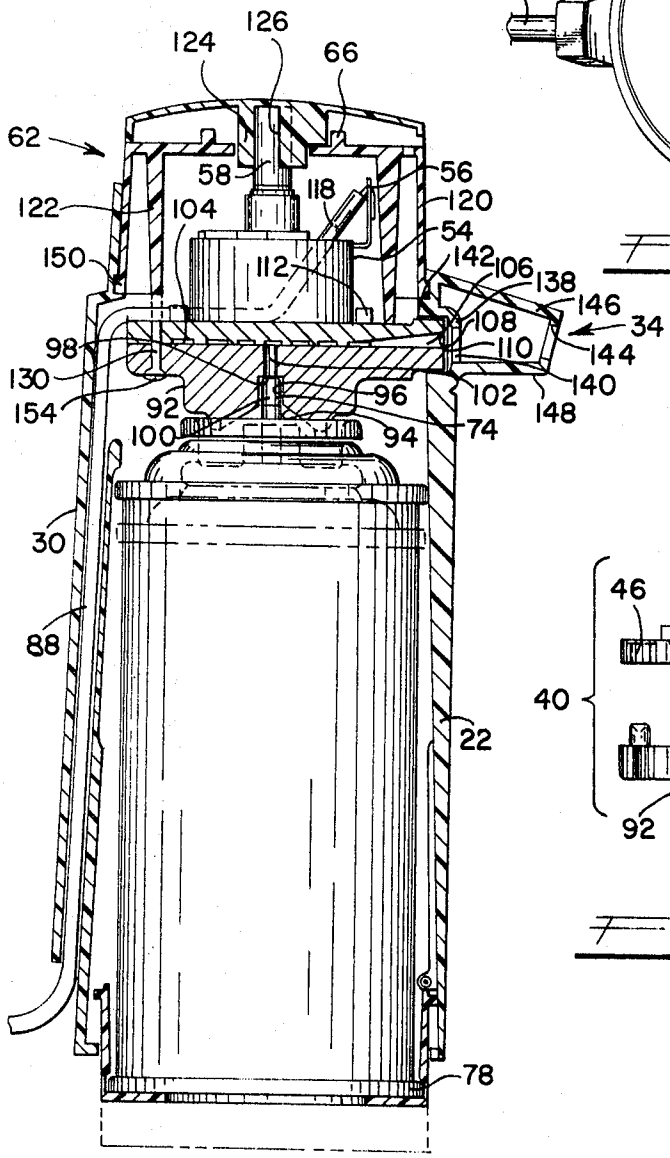


FIG. 3



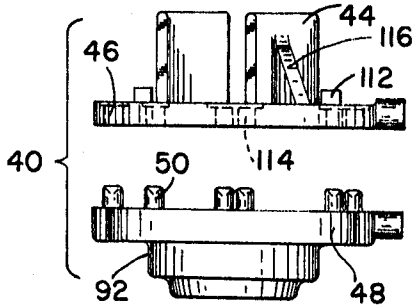


FIG. 4

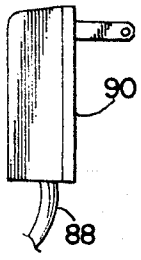


FIG. 2

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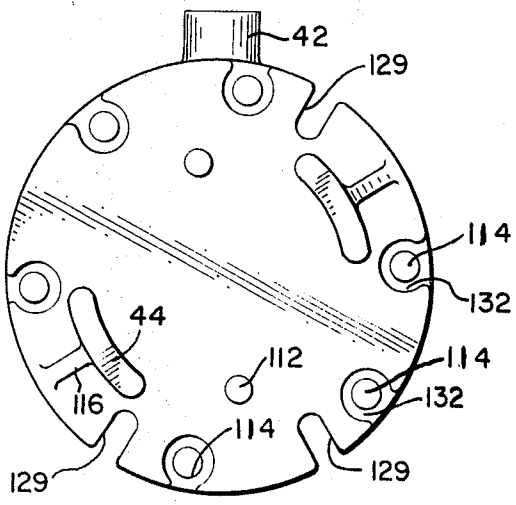


FIG. 5

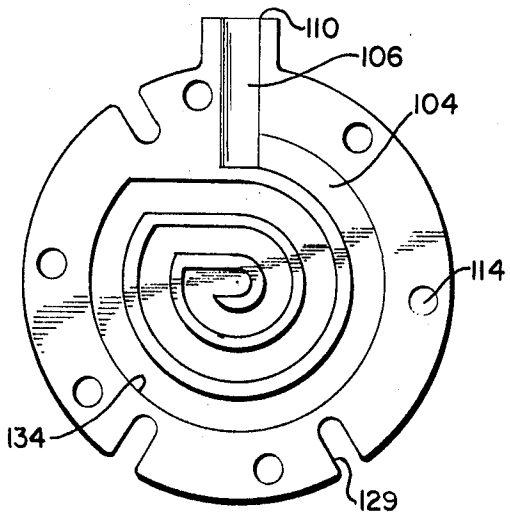


FIG. 6

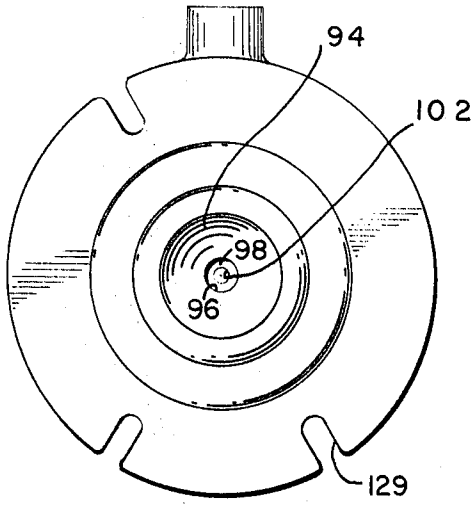


FIG. 7

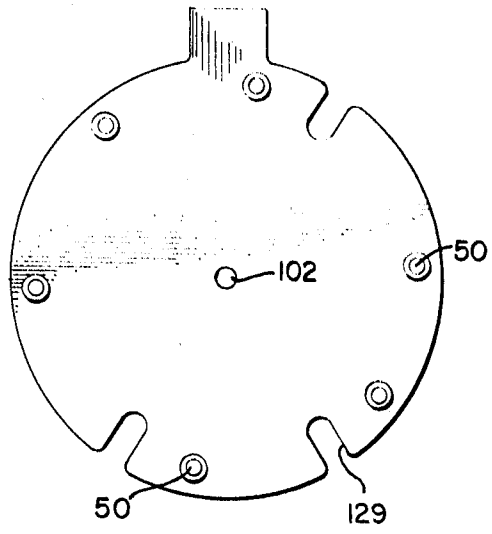


FIG. 8

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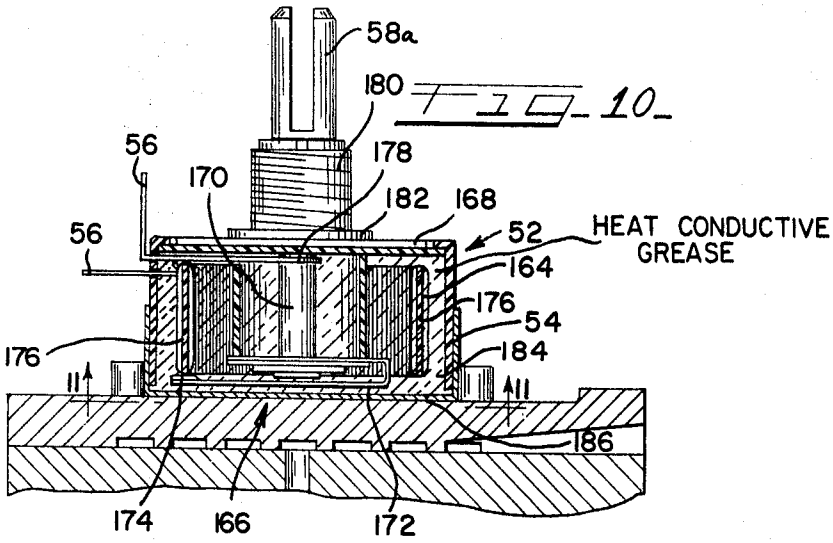


FIG. 10

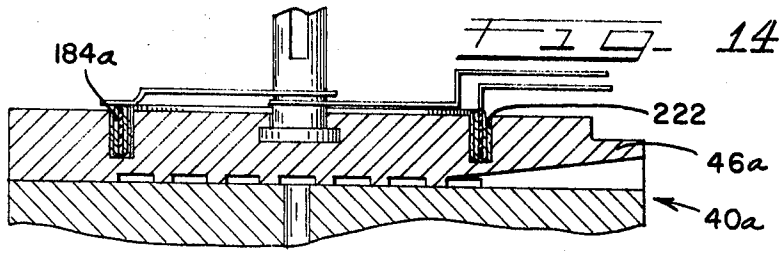


FIG. 14

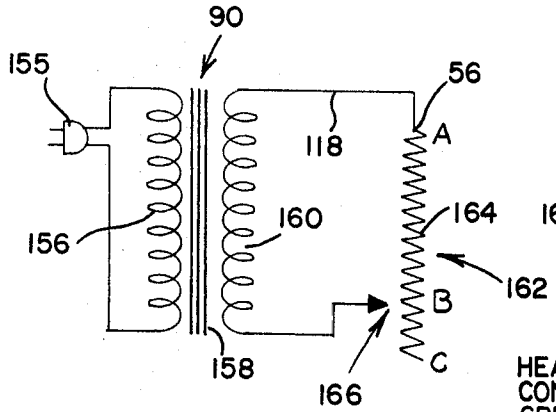


FIG. 9

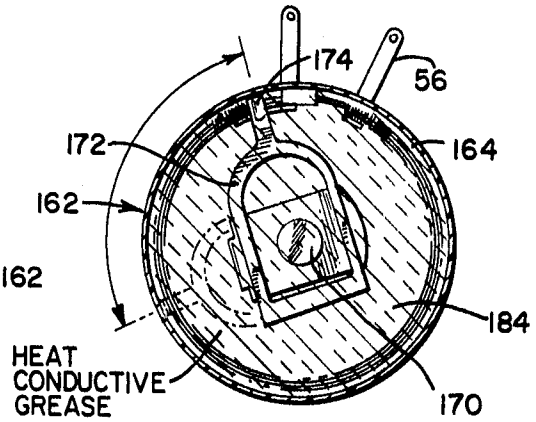


FIG. 11

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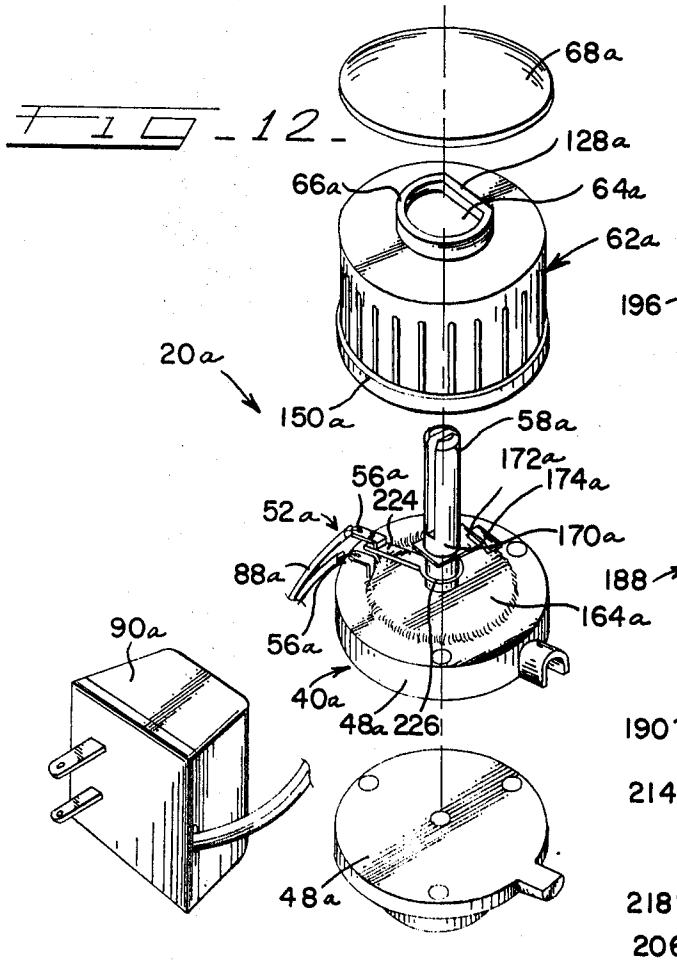


FIG - 12

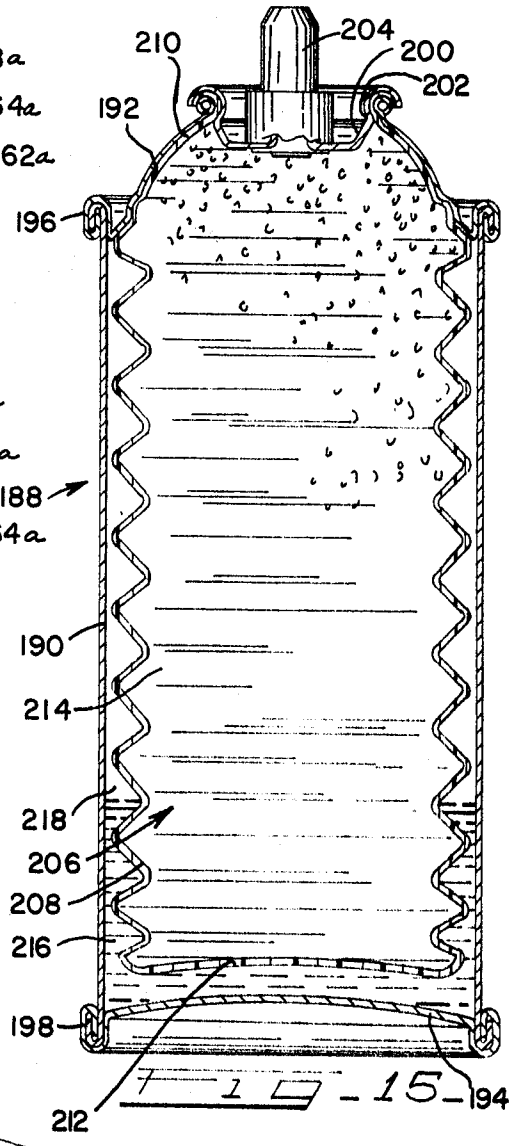


FIG - 15

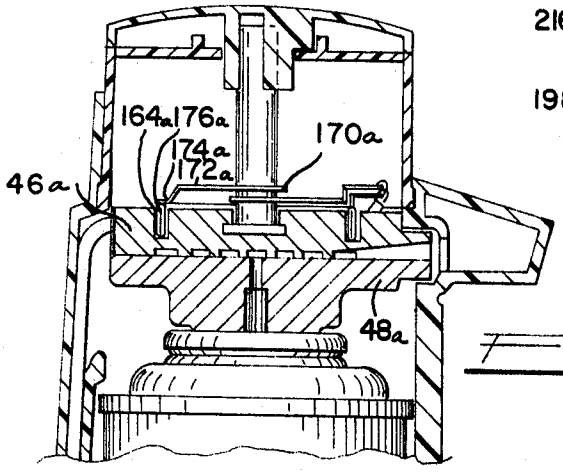


FIG - 13

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UNIT FOR HEATING AND DISPENSING AEROSOL PRODUCTS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The field of the present invention is that of combination heater and dispenser units. In particular, the field is that of units adapted to be used with aerosol containers, in which the heating means includes a control means, and in which the disposition of the parts and selection of materials is such that high efficiency may be maintained, while a variable temperature control arrangement may be incorporated at very low cost. In another aspect, the field of the invention is that of improved heat exchange devices and heater elements therefor, particularly wherein the heat which would be generated in a rheostat-heating element, is rapidly supplied to a relatively massive heat exchanger unit, thereby making efficient use of the rheostat as a heating element and allowing a greater quantity of heat to be transferred through a unit of lower power rating than would otherwise be possible.

In another aspect, the invention relates to means associated with the dispenser, in the form of a novel nozzle or spout unit, which prevents undesired discharge of an expansible foam product from the nozzle, after closing the actuating means supplying the foamable product from an aerosol container.

In still another aspect, the field of the invention is that of improved aerosol products, and containers including such products, wherein the product and its foaming agent are contained in a flexible inner compartment of a container, and in which the propellent component is contained in another, rigid compartment of the container. As the propellant undergoes vaporization from a liquid stage at a given equilibrium temperature, the product in the interior compartment is dispensed with a relatively constant overpressure thereon. One aspect of the invention is therefore that of aerosol compositions which are designed to maintain a relatively constant percentage of a volatile component even after dispensing significant amounts thereof.

2. Description of the Prior Art

In general, aerosol heating and dispensing devices of the prior art have fallen into the category of those in which the product to be dispensed, generally in the form of a foamable composition, was heated by means of a heat exchanger which was warmed by being contacted with hot water. In the case of such aerosol dispensers, the heat was absorbed from the water and held in a heat exchanger until the dispensing operation was performed. Units such as these are satisfactory in some cases, but they are only useful immediately after the heat exchanger has been exposed to the hot water, and are obviously useful only where significant amounts of sufficiently hot water are readily available. In addition, such dispenser units must be used immediately after the heat exchanger has been warmed, rather than sometime thereafter, and accordingly, such units are limited to use under such conditions.

Another form of heat exchanger device contains an electrically heated heat exchanger. In such units, the advantages of electric heating are present, and although such units have been commercially successful to a certain extent, they are capable of improvement. In general, such units of the prior art are adapted to be plugged in or switched on shortly or immediately before use, and a certain warmup period is generally required before the heat exchanger reaches the desired temperature. Units capable of fast warmup generally include a heating element of relatively high capacity and relatively large size, and if it is desired to use them frequently, such as in barber shops, they must be switched on and off a number of times. If they are used infrequently, a given warmup time must be allowed before they are usable. Accordingly, such units are not advantageously used where a heated product is desirably available at all times, or where the units are to be turned on and off frequently.

Thus, the prior art has not provided an electrically heated dispenser unit which may be economically used in continuous operation, that is, one which may be energized and left in an "on" position for a relatively long time so that the same may be always ready for use, and yet not consume significant amounts of current between uses thereof. Particularly, the art has not taught the use of very efficient, but reliable and inexpensive heating elements, heat exchangers, and means for localizing the heat generated in a desired area, where it may be retained for a reasonable time.

Prior art shaving compositions, and pressurized cans containing such compositions, have also presented a further problem to the prior art. For example, in the case of an ordinary shaving compositions dispensed through an electrically heated heat exchanger, the user of the heated lather was able to detect that there was a considerable variation in the temperature of the lather emanating from a full container and the temperature of the lather coming from a nearly empty can. This is a result of the change of proportions of the constituents of the product during dispensing, that is, there is a reduction in the percentage of the combination volatile propellant and foaming agent therein when the product supply in the container can is nearly exhausted as compared to when it is nearly full. With a heat exchanger of given heat capacity, the result is a lather or cream varying in dispensing temperature, since exposure of the same amount of lather to the same amount of heat for the same time creates a lower temperature in a foam having greater heat capacity. Such compositions and containers, accordingly, when used with combination dispenser and heating units, possessed this characteristic drawback.

Another shortcoming in combination dispenser and heating units of the prior art is that foam contained in the heat exchanger tends to continue to foam out of the discharge nozzle even after the supply of product is shut off, that is, dispensers with large nozzles tend to "drool" after use.

SUMMARY OF THE INVENTION

Accordingly, in view of the shortcomings possessed by certain prior art devices, and the apparent failure of attempts to solve the problems inherent with an aerosol product heater and dispenser, there has been a need for an economical and reliable combination dispenser and product heater having a relatively large heat capacity, being in simple construction, and having other novel features and advantages.

Another object of the invention is to provide a combination dispenser and heating unit in which the heat exchanger is a relatively massive metal element in intimate heat exchange contact with a variable resistance heater unit, and which includes an additional heat transfer and electrical insulation means surrounding the heating element to increase the effectiveness thereof in use of the unit.

A further object of the invention is to provide a heater and dispenser unit in which the heating element is a rheostat unit, and in which the current fed to the rheostat is furnished through a stepdown transformer.

The further object of the invention is to provide a combination heating and dispenser unit including a rheostat and a transformer, wherein the resistance of the rheostat may be adjusted so as to match the impedance of the transformer secondary, or to differ widely therefrom.

Another object of the invention is to provide an aerosol composition and container therefor, in which the product and foaming agent are contained in an inner, collapsible portion of the container, and the propellant in an outer, rigid portion, and in which the propellant is present in both the gas or liquid and gas phase, thereby serving to exert a relatively constant dispensing pressure and counterpressure on the composition.

Another object is to provide a dispenser for use with foamable aerosol products in which means are provided for preventing excessive expansion and discharge of the foamed product from the heat exchanger after the product supply to the heat exchanger has been cut off.

A further object is to provide a dispenser having the above advantages and characteristics, which is capable of being

manufactured economically and which affords a high degree of reliability and safety in use.

Another object is to provide an aerosol heater and dispenser which is capable of providing excellent results with specially prepared foamable compositions and containers, but which will also provide excellent results with ordinary foamable aerosol compositions.

The present invention achieves these objects, and others which are inherent therein, by providing a dispenser unit for heating and dispensing an aerosol product, which includes an exterior shell with an opening at one end thereof, and a heater and dispenser unit at the other end which comprises a relatively massive heat exchanger having an inlet, an outlet, and a circuitous passage connecting the two, and variable resistance heating element means for heating the heat exchanger. Additionally, the invention achieves other objects by providing a composition and container combination wherein a propellant is contained in the outer portion of a container, the foamable composition, including the foaming agent, is contained in an inner, flexible compartment of the same container, and in which the propellant and the foamable composition each include components which are present both in the liquid and in the gas phase. Further, the invention achieves its objects by providing an improved nozzle construction in the dispenser unit for eliminating undesirable after dispensing or "drool." Preferably, the dispenser includes additional means for facilitating heat transfer between the heating element means and the heat exchanger.

The exact manner in which the invention accomplishes these, and other inherent objects and advantages, will become more apparent when the description proceeds, and particularly when the description of the invention is considered in conjunction with the accompanying drawings, in which like reference numerals indicate corresponding parts throughout.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view of the combination heating and dispensing unit of the invention, showing the principal elements thereof;

FIG. 2 is a vertical sectional view, taken through the heating and dispensing unit of the invention, which is shown in association with a container of the product to be dispensed;

FIG. 3 is a top plan view of the heater and dispenser unit of the invention;

FIG. 4 is an exploded view of one form of heat exchanger of the invention;

FIG. 5 is a top plan view of the upper portion of the heat exchanger of FIG. 4;

FIG. 6 is a bottom plan view of the upper portion of the heat exchanger;

FIG. 7 is a bottom plan view of the lower portion of the heat exchanger;

FIG. 8 is a top plan view of the lower portion of the heat exchanger;

FIG. 9 is an electrical schematic diagram of the transformer and heating element means of the invention;

FIG. 10 is an enlarged vertical sectional view, with portions broken away, of the heating element means and a part of the heat exchanger of the invention;

FIG. 11 is a horizontal sectional view of the heating element means of FIG. 10, taken along lines 11–11 thereof;

FIG. 12 is an exploded perspective view of a modified form of the heat element means and heat exchanger of the invention;

FIG. 13 is an enlarged vertical sectional view, with portions broken away, showing the modified form of the heating element and heat exchanger of FIG. 12;

FIG. 14 is a further enlarged vertical sectional view of the heating element means and heat exchanger of FIGS. 12 and 13;

FIG. 15 is a vertical sectional view of a container unit and product therein which is preferred for use with the dispenser of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

Referring now to the drawings in greater detail, the combination heating and dispensing unit is shown at 20 in FIG. 1. The principal components of the illustrated unit comprise the shell 22 which includes left- and right-hand halves 24,26, each including vent means 28 on the sides thereof, cord housing means 30 at the rear thereof, nozzle forming portions 32,34, and means in the form of a supporting flange 36 near the bottom of the shell 22 for supporting an aerosol container, and a ramp 38, which forms, in combination with other portions of the flange 36, means for removably receiving an aerosol container or parts associated therewith, and for allowing free but limited movement of such container vertically within the shell.

Another principal element of the dispenser is the heat exchanger unit 40, which will be described in further detail herein, but which is here shown to include outlet means 42 for a product, and projections 44 extending upwardly from the upper portion 46 of the heat exchanger 40. A lower portion 48 is secured by fasteners 50 or the like to the upper portion 46 of the heat exchanger 40.

Another principal component of the invention is the heating element means 52, which is shown in the form of a rheostat having an exterior cover 54, electric lead means in the form of terminals 56 and control means in the form of a stem 58 which is rotatably received in the top cover portion 60 of the heating element 52. The other features of this unit will be described in further detail herein.

FIG. 1 also shows a top cover means in the form of a cover element 62 which includes a central opening 64 in the top thereof to allow projection of the shaft 58 therethrough, and means in the form of a ring 66 for receiving a dial unit 68 disposed on top of the cover 62. The remaining principal elements of the invention comprise an aerosol container 70 and a base unit 72, the container having an outlet in the form of a vertically extending, cylindrical valve 74 supported in a mounting cup 76. The base 72 receives the bottom double seam 78 of the container 70, and includes a bottom wall 80, sidewalls 82, means in the form of a groove 84 for receiving the double seam 78, and a plurality of locking and supporting lugs 86 disposed about the upper periphery thereof. The lugs 86 are adapted, upon rotation of the can within the shell, to ride upwardly on the ramp 38 and, after positioning the container within the shell 32, to remain in position on top of the flange 36, thus supporting the can or container 70 in position of use within the shell 22.

Referring now to FIG. 2, certain construction features of the unit are better shown. This view shows that the shell 22, upon assembly, forms a unitary cover, and that the container 70 is movable within the shell 22 as shown in the phantom lines. Extreme downward movement is limited by the engagement of the lugs 86 with the flange 36, and upward movement is limited by the travel limit of the aerosol valve 74 or the engagement of the upper portions of the mounting cup 76 with the lower portion 48 of the heat exchanger. A cord unit 88 is supplied for connection to a transformer assembly 90 which will be described in further detail herein. The housing 30 supports the cord 88 in place within the shell 22.

Referring now to the construction of the heat exchanger, it will be seen that the unit is of massive, substantially solid metal construction and that it includes a downwardly extending, reduced diameter boss 92 having a re-entrant portion 94, terminating in inwardly facing, vertical cylindrical walls 96, surmounted by a shoulder 98, the walls and shoulder 98 serving to define a cylindrical opening 100 for accommodating the valve 74. An inlet passage 102, also cylindrical in shape, communicates with the interior of the heat exchanger, and communicates with the labyrinthine, or circuitous passage means 104 which terminate in a passage 106 having a top wall portion 108 which tapers upwardly as it extends outwardly, the passage 106 terminating in an outlet opening 110. The upper portion 46 of the heat exchanger is generally of a flat, platelike configuration, with the exception of the projection or ribs 44

(FIG. 4) which extend upwardly, and the locating bosses 112 for receiving the heat element means 52.

Referring now particularly to FIG. 2 and 4, it is shown that in assembled position of use, the upper and lower portions 46,48 of the heat exchanger are held in close proximity and in effect, form one relatively massive unit.

Referring again to FIG. 4, fastener means in the form of rivets 50 are shown to be adapted to be received in openings 114 in the upper portion 46 of the heat exchanger 40, by expanding the top portions thereof, in a conventional staking operation.

A preferred form of the heat exchanger 40 provides stiffening means in the form of gussets 116 which support the projections 44 and aid in heat transfer downwardly therefrom to the plates 46,48 of the heat exchanger 40.

Referring again to FIG. 2, it may be seen that the bosses 112 serve to assist in locating the heating element 52, by engaging the outer portions of the cover 54 thereof. One lead 118 of the cord 88 is shown to be engaged with a terminal 56 to supply current to the inside of the cover 54 which includes heating element means 52 in the form of a rheostat unit to be described in further detail herein. Since it is desired that the heating element 52 be placed in intimate heat exchange relation with the exchanger, so that heat generated therein will be transferred to the heat exchanger over a relatively large area thereof, it is preferred to dispose a layer of a filled, heat conducting grease or other material is disposed between the bottom portion of the cover 54 and the top portion of the upper portion 46 of the heat exchanger 40.

FIG. 2 also shows that the top cover 62 includes outer, generally cylindrical walls 120, and inner, generally cylindrical walls 122 which are received on a portion of the heat exchanger, and that the ring 66 serves to receive, on an inner portion thereof, a projection 124 extending downwardly from the dial unit 68. The projections 124 includes a slot or keyway 126 for engagement with the stem 58 of the heat exchanger. Although the opening 64 in the cover 62 is circular, dial stop means in the form of a flat surface 128 (FIG. 1) forming a chord across the interior surface of the ring 66 limit rotation of the dial 68. This feature serves to provide a limit to the degree of rotational travel allowed by the disc. Typically, the dial 68 may be rotated through an arc of about 90° to 180°, adjusting the resistance of the rheostat in a manner to be described more fully herein. Proper alignment of the dial, cover and shaft are provided, since the inner cylindrical walls 122 of the cover 62 rest in a position on the top surface of the upper portion 46 of the heat exchanger which is determined by the legs 130 of the inner walls 122.

Referring now to FIGS. 5 through 8, the construction of the heat exchanger is shown in greater detail. These FIGS. show that the outlet means 42 is in the form of a short spout, and that a reentrant portion 129 extends radially inwardly and is adapted to receive the legs 130 (FIG. 1) which depend downwardly from the lower surface of the inner cylindrical wall 122 of the cover 62. The dial 68 is relatively rotatable, and the heat exchanger 52 has the cover portion 54 thereof held fixed against rotation, so that moving the dial serves to rotate the shaft 58 of the heat exchanger 40. The cover 62 supporting the dial 68 is fixed against rotation by the legs 130, which are held in place by the heads 132 formed thereon.

FIG. 5 shows the top surface of the plate 46, and recesses 132 for flush riveting the plates together. FIG. 6 shows the configuration of the passageway 104 which extends between the inlet 102 (FIG. 7) and the passage 106 communicating with the outlet 110. FIG. 6 also shows that the walls 134 forming the passageways 104 form additional heat transfer means for equalizing the temperature throughout the heat exchanger 40. FIG. 8 shows the substantially flat top surface portion of the lower portion 48 of the heat exchanger 40.

FIG. 7 illustrates the taper of the reentrant portion 94 of the heat exchanger which helps to center the nozzle 74 in the opening 100. In reference to FIGS. 5 through 8, it can be appreciated that the heat exchanger unit 40, which is preferably made of two pieces of aluminum, is of a very simple construction, and is designed so that the parts thereof may be die-cast or otherwise simply formed, and may thereafter be assembled together to form a unitary, relatively massive heat exchange unit with or without the use of adhesives, by a simple riveting or staking operation. The resulting heat exchanger has excellent thermal transfer characteristics to the foam moving through the passages and provides excellent heat distribution from the element 52 throughout the body of the heat exchanger 40.

Referring again to FIG. 2, it is shown that a generally cylindrical housing 138 forming a portion of the shell 22 and having a product inlet opening 140 therein is provided to receive the product outlet 42 of the heat exchanger 40. A very minute opening 142 between the upper portion of the product outlet 42 and the housing 138 is shown, the importance of which will be discussed later. Referring again to FIG. 2, the nozzle unit 34 is shown to include the inlet opening 140, a foamed product outlet 144, and top and bottom wall portions 146,148, in addition to the side portions 32,34 referred to above. The top wall 148 of the nozzle slopes upwardly as it extends inwardly towards the body of the shell 22, while the lower walls 146 are generally horizontal.

Preferably, positioning the elements in place with the dispenser unit is accomplished by the provision of an annular ring 150 extending outwardly from the lower portion of the cover 62. This ring 150 is received in a groove 152 disposed in the shell 22. In an assembled relation, the legs 130, including the heads 154 support the heat exchanger 40 in fixed relation to the cover 62 which is in turn held fixed by the ring and groove arrangement 150,152. The heating element means 52 may be mechanically locked or wedged in place between the two, or may be adhesively secured to the heat exchanger 40.

Referring now to FIGS. 9, 10 and 11, the electrical components of the invention, including the heating element means 52 are shown. FIG. 9 shows that a plug 155 or the like is adapted to receive 60 cycle alternating current from a household source, for example, and to feed the current therefrom to the primary winding 156 of the transformer 90, and that the transformer 90 includes a core 158 and a secondary winding 160, as well as leads making up a cord 88. Preferably, the transformer 90 is a stepdown transformer having a ratio of secondary to primary windings such that the output across the secondary is 24 volt alternating current. Preferably, the transformer is encapsulated into a single unit and isolated from the remainder of the heating and dispensing unit 20.

A rheostat unit 162 includes a fixed terminal 56, to which one of the leads 118 is attached, and a high resistance wire 164 of substantial length extends therefrom.

Movable terminal means 166 engages the resistance wire 164 at one point along the length thereof, and, as shown in FIG. 9, the resistance of the wire 164 in the secondary circuit at any one time is proportional to its effective length. In the present invention, the terminal is movable only between points B and C, and the resistance varies accordingly. Thus, if the full resistance available is represented by the length A to C, then the resistance at any time is equal to that resistance multiplied by the ratio of length A to B divided by length A to C. The significance of the adjustment means for the rheostat will be discussed in greater detail herein.

Referring now to FIG. 10, the heating element means 52 is shown to include the outer shell section 54, which is preferably made of metal, and to include a top cover 168 and a rotatable inner stem 170, to which is attached a contact arm 172 having a contact point 174 thereon. The resistance wire 164 is in the form of a coil and comprises a large plurality of turns of a fine, high resistance wire, disposed around an electrically insulating support core 176. Contact means in the form of a slipring 178 engaging the stem 170 completes the circuit between the upper terminal 56, the contact point 174 and the other end of the wire 164. The control stem 58 and the inner stem 170 associated therewith turn inside an outer collar

180, which is held in place by locking means 182 and is thus fixed against rotation.

A mass of filled, heat transferring grease or the like 184 is disposed within the heating element means 52, completely filling the inside of the outer cover 54, and surrounding the interior elements thereof. This material, which may be a silicone grease having a substantial proportion of finely ground zinc oxide therein, serves to dissipate the heat from the resistance wire 164 and direct it to the top portion 46 of the heat exchanger 40. The interface 186 between the top surface of the heat exchanger plate 46 and the bottom surface of the cover 54 may likewise be coated or filled with such material.

Referring now to FIG. 11, it is shown that the contact arm 172 is preferably designed to move through an arc of about 90° and 100°, and that the resistance through which the current is passing in various positions of adjustment varies between the resistance of the entire length of wire 164, when the arm 172 is in the position shown in solid lines, to about two-thirds to three-fourths of such resistance when the contact arm is in the position shown in the phantom lines. Thus, the dial 68 and the dial stop means 128 (FIG. 1) serve to permit movement, but limit it to an arc less than full rotation.

Accordingly, rotation of the dial 68 and the contact arm 172 operatively associated therewith serves to vary the amount of heat generated in the heating element means 52, and consequently, the amount of heat transferred to the heat exchanger 40.

When the resistance of the wire 164 in the length A—B is such that it matches the impedance of the secondary of the transformer, according to well-known electrical principles, the maximum amount of energy will be transferred to the rheostat, and accordingly, the maximum amount of heat will be generated. That is, when the external resistance or load of the cord 88 and the portion of the wire 164 between the terminals in equal to the impedance of the transformer secondary, maximum power is transferred. Since the relative resistance of the cord is very small substantially all of the power loss, and accordingly, heat generation, occurs in the rheostat. Moving the contact arm 174 clockwise as shown in FIG. 11 further increases the resistance to the point where greatly reduced current flows through the heating element means 52 at the voltage of the transformer, and accordingly only a small amount of power is consumed and a small amount of heat is transferred to the heat exchanger. If the design is such that the heat exchanger is desired to be left "on" continuously a certain minimum amount of heat is supplied thereto, maintaining an equilibrium at a temperature between 140° and 180° F., for example, as may be desired.

Accordingly, the resistance of the wire 164 used to make up the rheostat and the length thereof are calculated according to known principles, keeping in mind the impedance of the transformer, and the unit is wired so that a resistance along a part of the wire 164 may be made to approximate or equal that of the transformer secondary, and further wire is provided to increase the resistance of the heating coil to substantially diminish current flow through the heating coil.

In the embodiment just described, particular advantage is taken of the action of the heat conductive, electrically insulating grease. Since the grease performs the function of greatly aiding heat transfer from the rheostat to the heat exchanger, sufficient current may be passed through the rheostat to cause useful heating of the resistance coil thereof, without causing the rheostat to burn out. Heat transfer is also aided by the provision of the projections 44, the gussets 116, and the close physical association between the cover 54 and the upper portion 48 of the heat exchanger 40. The filled grease 184 is extremely viscous, and will not leak from the heating element means 52, even at extreme temperatures. Thus, in the operation of the unit, the transformer unit 90 is plugged into a source, and energy flowing from the secondary 160 thereof energizes the heat element means 52 to the extent determined by the position of the contact arm, 172, which in turn is controlled by the dial unit 68. Heat generated therein is transferred through the electrically insulated, heat conducting grease material to the heat exchanger 40 where it serves to heat the relatively massive heat exchanger to a temperature of about 140° to 180° F. Thereupon, a downward pressure exerted on the top of the dial 68 or elsewhere on the exterior shell 22 moves the entire assembly 20 downwardly relative to the base 72, in which the container 70 is locked, and thus, the valve 74 is moved downwardly within the fixed container for dispensing the product therefrom.

Thereupon, the foamable product contained in the container 70 moves through the opening 100, into the inlet passage 102, around the circuitous passage 104, and out the opening 110 at the end of the passage 106. The expanded, heated foamed cosmetic or like product then moves out the nozzle formed by the two portions 32,34 for reception by the user. When the downward pressure on the shell 22 is released, the resiliency afforded by the aerosol valve lifts the entire container shell 22 and the heating means associated therewith upwardly, cutting off the flow of product from the container 70.

One important feature of the present invention is that the very minute space or opening 142 disposed above the cylindrical housing 138 allows escape therethrough of any gaseous product which separates from the foam or emulsion which has completely filled the nozzle formed by the portions 32,34. In prior art designs, the continued heating of the product trapped in the high temperature region of the heat exchanger caused continued expansion thereof, pushing the product held in the nozzle outwardly in an undesirable "drooling" effect. This effect is minimized or precluded in the present design, since escape of gas upwardly through the opening 142 causes a slight vacuum effect which tends to prevent forward movement of the foam in the nozzle. The upwardly angled disposition of the top wall portion 108 of the passage 106 also contributes to this effect, since evolving gas tends to move upwardly along the slanted top wall 108, whereas the foam tends to remain on the bottom thereof. Although the exact reason for this behavior is not fully understood, it is known that when the opening 142 is provided, in combination with the upwardly and outwardly extending top wall 108, lather "drool" after actuation of the unit is either minimized or totally eliminated. Although the size of the unit illustrated is merely exemplary, with a heat exchanger of the construction illustrated, with the dial 68 at a high temperature setting, sufficient heated foam may be dispensed, for example, to provide in rapid succession, lather for four or five shaves or more without excessive loss of heat from the heat exchanger unit 40. On the other hand, when the dial 68 is moved so that the rheostat is set at a low heat position, the heat exchanger unit will maintain a desired temperature of between 140° and 180° F. without undue consumption of current. Because of the use of the stepdown transformer 90, which is isolated from the remainder of the unit, the danger of electrical short circuit hazards and the like are diminished, since relatively low voltage, high current operation is employed.

The provision of the relatively small passages 104 enhances the ability of heat exchanger 40 to transfer heat to the foam before the expansion of the foam is complete. Therefore, the inherent resistance of the foam to temperature rise caused by its own insulating properties is minimized, partially because the foam is largely in the liquid rather than in the emulsion form. Subsequent expansion of the foam, while causing a temperature drop, does not excessively lower the temperature thereof.

Referring now to FIG. 15, an aerosol container 188 having a foamable product therein, and especially adapted for use with the present invention, is shown. The features of this container 188 and the product therein, and the reasons why such container and product are preferred will now be discussed.

The container 188 is a conventional metal aerosol can, and includes an exterior body portion 190, an upper end or dome portion 192 and a lower, preferably concave bottom end portion 194, the ends 192,194 being affixed to the body 190 by conventional double seams 196,198, in a manner well known

in the art. An aerosol mounting cup **200** surmounts the dome, and is held in place therein by a crimped, outwardly extending bead **202** which is also conventional in the art. An aerosol dispensing valve **204**, of any well-known type, is affixed within the mounting cup **200**, for dispensing the product. Disposed inside the body **190** is an interior container **206**, the exterior walls **208** of which include a plurality of pleats or bellows. The upper portion of the inner container **206** is affixed to the mounting cup **200** in a liquid and gastight relation, as at the seam **210**. A bottom wall portion **212** joins the walls **208** to complete formation of the inner container **206**.

In accordance with the present invention, the inner container **206** contains a foamable product **214** having, for example, water, soap, and one or more additional emulsifying agents therein, as well as a gas emulsified or dissolved therein for purposes of expanding the product **214** when it is exposed to the atmosphere. For example, a hydrocarbon material such n-butane gas may be used, since this gas is readily maintained in the liquid state with a low overpressure or counterpressure, say 10 to 25 p.s.i., within a temperature range in which the invention would normally be used. Thus, the composition **214**, within the container is in a liquid state, but contains a volatile gas which is expanded, upon release to atmospheric pressure, without the need for application of additional heat. A liquid phase of the butane or like low-boiling gas will remain present as long as sufficient counterpressure is maintained thereon, and the flexible sidewalls **208** insure that such pressure will be transmitted to the interior of the container **206**.

Inside the outer body **190**, and outside the inner container **206** is a propellant **216** which is partially in the liquid form, and which also includes a vapor phase **218** in equilibrium with the liquid. A fluorocarbon gas or mixture thereof having a 72° F. vapor pressure of about 30 to 50 p.s.i. is typically used for this purpose. At an operating pressure of 40 pounds to a square inch, for example, and a temperature of 72° F., both liquid and vapor are present, and as long as a counterpressure or overpressure of 40 p.s.i. is maintained, more and more liquid fluorocarbon will volatilize as vapor is removed from the container, or as additional headspace is provided for expansion thereof without increasing the pressure, that is, by reduction in size of the inner container **206**.

With a container having a volatilizable liquid propellent **216** held outside the inner container **206** and a shaving product, for example, kept within the inner container **206**, upon dispensing the contents, foamable product **214**, not having a portion of the contents thereof volatilized until after dispensing from the container **206**, retains the same relative proportion of vaporizable and liquid material until all of the product **214** is dispensed.

Inasmuch as the relative proportion of ingredients within the inner container **206** remains the same during successive dispensing operations, the heat capacity thereof also remains the same, and the foam is dispensed at a uniform temperature, regardless of the amount of product remaining in the inner container **206**. In prior art containers and compositions, since the more volatile components were exhausted from the solutions or emulsions before the less volatile components, the lather or other composition would vary in temperature as its composition and heat capacity varied during dispensing. Accordingly, the combination of the flexible inner container with the use of propellants and foaming agents having the liquid-vapor phases and pressure relationships set forth herein is particularly advantageous for use with the combination heating unit, and dispenser of the present invention.

Referring now to FIGS. **12**, **13** and **14**, modified forms of some of the elements of the combination heating and dispensing unit **20***a* of the invention are shown. Referring particularly to FIG. **12**, the dial **68***a* is shown surmounting the cover **62***a*, which includes the opening **64***a* through the ring **66***a* having the chord member or dial stop **128***a* associated therewith. The cover element **62***a* also includes the supporting ring **150***a*. A transformer unit **90***a* is similar to its counterpart in the earlier described embodiment. In this embodiment, however, the heating element means **52***a* is combined into a single unit with the heat exchanger **40***a*, and the resistance wire **164***a* is embedded in the top plate **46***a* of the unit. Terminals **56***a* are connected to the cord **88***a*, and a contact arm **172***a* terminating in a contact point **174***a* is disposed on the lower portion of the stem **170***a* for establishing electrical contact with the coil of wire **164***a* and the terminal **56***a* associated therewith. The wire **164***a* is wound around an electrically insulated core **176***a*, and insulating grease **184***a* is disposed in the recess **222** within the upper portion plate **46***a* of the heat exchanger **402**. The radially inner end of the contact arm **224** which is attached to the terminal **56***a* includes a slip ring **226** surrounding the lower portion **170***a* of the control stem **58***a*. The bottom portion of the heat exchanger **48***a*, the passages therein, and the other elements thereof are similar to their counterparts shown in FIG. **1** through **8**. In all operations respects, the unit shown in FIGS. **12—14** is the same as that shown in FIGS. **1** through **6**. The differences residing in the construction of the heat exchanger, and other variations of the basic concept of the invention, are structural only.

The heat exchanger means **52**, shown, for example, in FIGS. **1—8** and **10—11** represents a modification of a commercially available rheostat modified so as to render it suitable for use as a heating element, whereas the form of the heat exchanger and heating element means shown in FIGS. **12** through **14** represents a modification made to an existing heat exchanger to accommodate the desired rheostat construction. This form provides increased efficiency and economy, by reason of surrounding the resistance wire **164***a* on three sides with the upper portion **46***a* of the heat exchanger **52***a*.

One particularly advantageous aspect of the invention is the use of the filled insulating grease in combination with a rheostat unit to provide a heating element having excellent heat transfer characteristics. Such a grease, which is preferably a silicone grease having substantial portions of an inert filler therein, such as zinc oxide, to increase the heat transfer rate thereof, is commercially available, General Electric "Insul Grease 641" and Dow Corning "Heat Sink Compound 340" being typical brands thereof. The use of the thermally conductive, electrically insulating grease makes it possible to utilize a relatively lighter less expensive rheostat than could normally be used, or to use a lighter duty rheostat in place of a more expensive heating coil. In this aspect, the heating element is useful in environments other than with the dispenser unit of the present invention; it is useful in several other applications, including other forms of electrically heated appliances. For example, a typical rheostat normally rated at 4 watts, when exposed to ambient air at 70° F., and having 4 watts of energy passed therethrough, will rapidly heat to 420° F. or more, and, if maintained at such temperature, will rapidly burn out. However, if the rheostat is packed with a filled, heat conductive, electrically insulating grease, the rheostat will not rise above a temperature of 320° F., even where the ambient temperature rises to as much as 200° F. Thus, placing the rheostat in intimate heat exchange relation with an element to be heated, and surrounding the resistance coils thereof with a thermally conductive, electrically insulating compound, enables sufficient heat to be transferred away from the rheostat so that the rheostat will not overheat. On the other hand, if no heat-conductive grease is used, a resistance heating element, particularly a rheostat, would have to be much heavier for the same heat output. Thus, one aspect of the present invention is the provision of an improved heating unit for appliances and the like, particularly a variable current, variable temperature heating unit of very low cost.

It will thus be seen that the present invention provides a novel heating element means, a novel heating element and heat exchanger assembly for use in a dispenser, a novel combination foamable product, propellant and container, and a novel combination heating and dispensing unit for an aerosol product, having numerous advantages and characteristics, including those hereinbefore pointed out, and others which are inherent in the invention.

I claim:

1. A dispenser unit for heating and dispensing an aerosol product from a pressurized container, said dispenser comprising, in combination, an exterior shell member having an opening at one end thereof for receiving an aerosol container, and a product heater and dispenser in the other end of said shell, said heater and dispenser comprising a heat exchanger having and inlet for receiving a product dispensed from an aerosol container, an outlet for such product, and circuitous passage means connecting said inlet to said outlet, said outlet in said heat exchanger being generally horizontally directed and including a passage having a top wall portion which tapers upwardly as it extends outwardly, said passage terminating in an outlet opening, said exterior shell member, including an exterior, product dispensing nozzle associated therewith, said nozzle including a dispensing opening and being in communication with said outlet opening at a substantially foamtight connection, said nozzle having a substantially larger cross-sectional area than said outlet opening and vent means for allowing gaseous product-foaming components to escape upwardly within the foamtight connection between said heat exchanger outlet opening and said nozzle dispensing opening.

2. A dispenser unit for heating and dispensing an aerosol product from a pressurized container, said dispenser comprising, in combination, an exterior shell member having an opening at one end thereof for receiving an aerosol container, and a product heater and dispenser in the other end of said shell, said heater and dispenser comprising a heat exchanger having an inlet for receiving a product dispensed from an aerosol container, an outlet for such product, circuitous passage means connecting said inlet to said outlet, and variable resistance heating element means for heating said heat exchanger, said heating element means being in the form of a manually adjustable rheostat having a resistance element therein and means lying externally thereof for selectively adjusting the resistance value thereof, said rheostat having an exterior metal cover and being disposed atop said heat exchanger, said heat exchanger including generally vertically extending portions contacting said metal cover, the manually adjustable rheostat having the interior portion thereof filled with an electrically insulating, thermally conductive heat transfer material to facilitate heat transfer between said resistance element of said rheostat and said heat exchanger.

3. A dispenser unit for heating and dispensing an aerosol product from a pressurized container, said dispenser comprising, in combination, an exterior shell member having an opening at one end thereof for receiving an aerosol container, a product heater and dispenser in the other end of said shell, a stepdown transformer having a primary winding adapted to be operatively associated with a power source and a secondary winding for supplying current to said heater and dispenser unit, said heater and dispenser unit including a heat exchanger having a circuitous product passage therethrough for receiving product from said container and dispensing it from said heat exchanger in a heated condition, said unit further including a manually adjustable variable resistance heating element having the terminals thereof attached to said secondary winding, said resistance element being surrounded by and in intimate heat exchange relation with an electrically insulating, heat conductive material, said material being also in intimate heat exchange relation with a portion of said heat exchanger, said resistance element being adjustable at least between a first resistance value calculated to produce maximum power transfer in said transformer and another resistance value much higher than said first resistance value and adapted to produce a greatly reduced power transfer in said transformer.

4. A dispenser unit as defined in claim 3 in which said heat exchanger comprises a substantially solid mass of metal, with the thickness of the portions beneath said circuitous passage means and the thickness of the portions above said circuitous passage means being substantially greater than the height of said passage means.

5. A dispenser unit as defined in claim 3 in which said variable resistance heating element means is disposed within a groove in said heat exchanger, and in which said groove is filled with said heat transfer material for providing electrical insulation between said heating element means and said heat exchanger, and for increasing heat transfer between said heating element means and said heat exchanger.

6. A dispenser as defined in claim 3 in which said means for insulating said heating element means and for promoting said heat transfer comprises a silicone grease material including a filler associated therewith, said filler including a metallic oxide-containing compound having a higher heat transfer capacity than said silicone grease material.