HEATED AIR CURTAIN WARMER

Inventors: James E. Humphrey, Cheyenne, WY (US); Tod Heintzelman, Simpsonville, SC (US)

Filed: Aug. 20, 2011

Abstract

A heated air curtain warmer that has a plurality of loops wherein each loop has a duct and a fan corresponding to a heating element, wherein each fan provides an air flow wherein a portion of the airflow of each fan is divided between a portion that provides an air curtain and a portion that flows over and around the stored products that are to be heated. Each loop has a corresponding food storage container for storage of food products. A control system for controlling the temperature of each loop wherein each loop is associated with a zone wherein said control system provides a uniform temperature for the zone such that each zone is maintained at a predetermined temperature such that the control system controls the temperature of each heating element, fan and duct combination independent of but in concert with the others to provide a predetermined and uniform temperature of each zone of the apparatus. Preferably, the number of loops is 3 and the number of food storage containers is 2 and the associated number of zones is 2 wherein each zone is maintained at a distinct temperature.
HEATED AIR CURTAIN WARMER

[0001] This application claims benefit under Title 35 U.S.C 119(e) of U.S. Provisional Application Ser. No. 61/402,081 filed Aug. 23, 2010.

FIELD OF THE INVENTION

[0002] This invention relates to food storage devices, in particular, heated containers that have an easily accessible opening by using an air curtain to isolate the food storage compartment from the exterior environment to maintain the temperature of the food yet providing easy access to the user such that the stored food can be conveniently retrieved.

BACKGROUND OF THE INVENTION

[0003] Forced convection heating is commonly used to cook or warm food products. Fans are used to circulate heated air in the container. The moving air warms the food faster because it strips away the thin boundary layer of air that surrounds and insulates the food. Another benefit of forced convection is that it heats the interior of the container more uniformly than a radiant heating system.

[0004] Typically, a solid barrier such as a door is employed over the container opening as a barrier between the interior of the container and the exterior environment. A wide variety of access structures that permit a user to reach the interior have been disclosed such as a door that is usually hinged on one side or two doors can be used where one slides in front of the other. However, in a fast-paced food service industry especially places such as quick serve restaurants, any door that requires a user to open and then close it in order to obtain a stored food product will result in a loss of productivity and efficiency for the staff accessing the container.

[0005] A better arrangement is to use a heated air stream as both an air curtain as a barrier between the interior of the container and the exterior environment and to heat the food in the container. This arrangement provides easy access to the food in the container by staff while maintaining the desired temperature of the food and eliminates the need for opening and closing a door or other similar structure.

[0006] While an air curtain provides an effective barrier between the interior of the container and the exterior environment, the air curtain can be influenced by air currents in the exterior environment. Heating and cooling vents or opening and closing exterior or interior doors near the food container can easily make the interior of the device non-uniform with respect to the measured temperature from one part of the interior to another. These environmental influences can result in cooling of the interior of the cavity requiring additional heat to be applied to overcome the influence of these aforementioned environmental factors.

[0007] In wider food containers, this environmental influence may not affect temperature across the entire width of the unit. The air temperature in one portion of the container can be lowered by the environmental influence while the balance of the interior of the container remains unaffected. For a food container with a single zone temperature control, this may result in uneven temperatures in the interior of the container. Accordingly, it would be desirable to provide an improved control system to maintain uniform temperature in the food container. For multiple zone temperature control, it would be desirable to provide an improved control system to maintain uniform temperature in each food container zone across the width of each zone.

SUMMARY OF THE INVENTION

[0008] It is an aspect of the invention to provide a heated air curtain warmer that has a single opening accessible through an air curtain by which food is moved between the interior and exterior of the apparatus.

[0009] It is still another aspect of the invention to provide a heated air curtain warmer that has at least one support surface inside the apparatus to support the food items that are to be stored.

[0010] Another aspect of the invention is to provide a heated air curtain warmer that has a plurality of heating elements disposed in the apparatus.

[0011] Still another aspect of the invention is to provide a heated air curtain warmer that has a plurality of fans, each fan corresponding to a particular heating element, wherein each fan provides an airflow wherein a portion of the airflow of each fan is divided between a portion that provides an air curtain and a portion that flows over and around the stored products that are to be heated.

[0012] It is an aspect of the invention to provide a heated air curtain warmer that has a plurality of ducts, with one duct for each heating element and its corresponding fan such that each duct, fan, heating element combination is responsible for maintaining a corresponding volume of the storage area and the air curtain access to a portion of stored products.

[0013] It is still another aspect of the invention to provide a heated air curtain warmer that has at least one zone wherein each at least one zone has at least one duct with a corresponding heating element and a corresponding fan such that each at least one zone can be maintained at a distinct temperature.

[0014] Finally, it is an aspect of the invention to provide a heated air curtain warmer that has a control system to control the temperature of each heating element, fan and duct combination independent of but in concert with the others to provide a predetermined and uniform temperature of the apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. 1 is a top perspective view of the heated air curtain warmer in accordance with the invention.

[0016] FIG. 2 is a top perspective view of the warmer shown in FIG. 1 with the top panel & upper duct top removed.

[0017] FIG. 3 is a cross-sectional side view of the container from FIG. 1 along line 3-3.

[0018] FIG. 4 is a cross-sectional front view of the container from FIG. 1 along line 4-4.

[0019] FIG. 5 is a detailed end view of the deflector giving the part size ratios.

[0020] FIG. 6 is a detailed end view of the deflector showing the airflow configuration.

[0021] FIG. 7 is a front view of an alternative embodiment of the heated air curtain with the apparatus divided into two zones, single loop zone and a double loop zone with each loop comprising its own duct with a corresponding heating element and a corresponding fan.

DETAILLED DESCRIPTION OF THE INVENTION

[0022] As shown in FIG. 1, invention 10 has interior chamber 12 which houses food items in a temperature controlled...
environment. Invention 10 is shaped similarly to a box with opening 14 on one side through which food is moved between the interior and exterior of invention 10. Opening 14 is quadrilateral and substantially planar and is located substantially perpendicular to the bottom of chamber 12.

[0023] Pans 16, shown in FIG. 3, are used to support the food items. Pans 16 are of sufficient size to pass through opening 14. The pans are supported by a wire rack system 18 or other suitable system in chamber 12.

[0024] As shown in FIG. 2, invention 10 features more than one fan 20 and duct system 22 which are configured to create air curtain 30 and to circulate air stream 32 through invention 10. Fans 20 are electrically operated and configured to provide constant airflow. Fans 20 are provided with outside ventilation by cooling fans 40. The air stream generated by cooling fans 40 is kept separate form air stream 32. The air stream generated by cooling fans 40 may prevent fans 20 from overheating.

[0025] Again referring to FIG. 3, the general flow of air curtain 30 and air stream 32 is depicted. Air curtain 30 forms a barrier between interior chamber 12 and the exterior environment. A user can easily reach through air curtain 30 to move food items between interior chamber 12 and the exterior of invention 10 thus eliminating the need for hinged doors on invention 10.

[0026] Fan 20 blows air into baffle box 24. Baffle box 24 is substantially enclosed having baffle 26 on the side opposite fan 20. Heating element 28 is disposed in baffle box 24. Air stream 32 is forced through heating element 28 heating air stream 32. Heating element 28 is of the open coil design. Open coil heating elements provide better heat transfer to air stream 32 than do the tubular sheathed heating elements commonly used.

[0027] After being heated, air stream 32 passes through baffle 26. Baffle 26 has a perforated, substantially planar, plate. The shape, size and quantity of perforations in baffle 26 are used to regulate the temperature of air stream 32 between 200 and 230 degrees Fahrenheit. The size of the perforations are determined empirically using airflow measuring techniques well known in the art to be 3/16 inch diameter obrounds 1/2 inch long. The perforations are configured in 23 columns spaced 3/16 inches on center with 3 perforations spaced 3/16 inches on center per column.

[0028] After passing through baffle 26, air stream 32 passes through upper ducts 50, 52 and 54, which are part of the duct system 22. (Shown in FIG. 2) Each air stream 32 provided by the corresponding pair of fan 20 and heating element 28 are segregated by baffles 56. Segmenting the air streams in this manner allows for the temperature of each fan 20 and heating element 28 to be controlled independently of the others.

[0029] Air stream 32 then passes through duct 60, which is a part of duct system 22. As air stream 32 passes through duct 60, the velocity is increased due to the reduced area air stream 32 has to pass through. Air stream 32 is directed through duct 60 by nozzles 62 which are adjacent to opening 14 in a downward direction. Air stream 32 passing over opening 14 creates air curtain 30.

[0030] Referring now to FIG. 4, air from the air curtain 30 returns to fan 20 through return ducts 64, 66 and 68 and a plurality of air returns 70 in duct system 22. The return ducts 64, 66 and 68 and air returns 70 are positioned on the side opposite opening 14. Typically, most of air stream 72 returns to fans 20 through return ducts 64, 66 and 68 and air returns 70. Food in pans 56 is placed between opening 54 and return ducts 64, 66 and 68 and air returns 70. A portion of the air stream passes over and/or around the food before entering return ducts 64, 66 and 68 and air returns 70. Thus, the temperature of the air in interior chamber 12 can be controlled using air from the air stream 32. The portions of air stream 32 from upper ducts 50, 52 and 54 substantially remain separated as they pass through interior chamber 12. This allows the temperature of each portion of interior chamber 12 to be controlled independently of each other.

[0031] Air returns 70 have a substantially uniform pattern of perforations. The density and size of the perforations is configured so that air stream 32 will pass over and/or around the pans uniformly throughout the interior chamber.

[0032] Return ducts 64, 66 and 68 are separate ducts through which air stream 32 is returned to fans 20. Air from the pattern of air returns 70 directly above each return duct 64, 66 and 68 passes through the corresponding return duct 64, 66 and 68. Return ducts 64, 66 and 68 in conjunction with the corresponding upper ducts 50, 52 and 54 create separate airflow loops within interior chamber 12.

[0033] Invention 10 features a control system used to maintain the temperature of the interior chamber 12 substantially constant. The control system is configured to control the temperature of the separate airflow loops described above independently of each other. The control system utilizes at least three temperature probes 80. Temperature probe 80 is located in each of the return ducts 64, 66 and 68. Temperature probe 80 in each return duct 64, 66 and 68 senses the temperature in that duct independent of the other two.

[0034] The balance of the control system is achieved by a separate input for each of the temperature probes 80 and a corresponding output relay for each temperature probe 80. The control system is configured as individual thermostats controlling the heating element 28 corresponding to each temperature probe 80 independently of the other thermostats. The control system is configured for a "user input" set temperature value, temperature offset value and hysteresis value. When turned on, each thermostat energizes the corresponding output relay to energize the corresponding heating element 28. The thermostat de-energizes the control relay and corresponding heating element 28 when the temperature probe 80 senses a temperature equal to the set temperature value plus the temperature offset value. As the temperature in the air loop drops, the thermostat energizes the control relay and corresponding heating element 28 again when the temperature probe 80 senses a temperature equal to the set temperature value minus the hysteresis.

[0035] A portion of air curtain 30 could be disturbed by an exterior influence 34. In such a case, the temperature probe 80 in the affected air loop may sense a lower temperature than temperature probes 80 in the other zones. As a result, the control system may energize heating element 28 in the affected airflow loop longer than the other heating elements 28 to maintain uniform temperature in interior chamber 12.

[0036] As shown in FIG. 1, control panel 82 is used to provide input (temperature set point & other variables) to the control system. The settings for each of the air flow loops described above can be set independent of the other air flow loops. Control panel 82 has buttons 84 and a display 86. Buttons 84 may be used to input desired setting values or to initiate the display of actual or set temperature values for all air loops as described above. The display 86 in configured to show the actual or set values of the control system parameters.
[0037] Referring to FIGS. 5 & 6, an end view of the lower deflector 90 is shown. Lower deflector 90 is the full width of the interior chamber 14 consisting of one side that is substantially vertical having a height “X” between approximately ¾ inches and 1 inch and a second side adjacent to the first at an angle β between 40° and 50° having a height “Y” between approximately ½ inches and ⅞ inches. As air curtain 30 reaches lower deflector 90, the first side and second side of lower deflector 90 may direct residual heated air from air curtain 30 into the interior chamber 14. Lower deflector 90 may prevent residual heated air from air curtain 30 from deflecting into the environment adjacent to invention 10 and increasing the ambient temperature of the adjacent environment. Additionally, the lower deflector 90 may catch food items spilled from pans 16 preventing spilled food items from contaminating any other food items below invention 10.

[0038] Referring now to FIG. 7, an alternative embodiment of the invention is shown. In this embodiment, three loops are present. Each loop has its own duct and corresponding heating element and fan. Zone 1, shown at the left, comprises a single loop and Zone 2, shown on the right, comprises two loops. Each zone can be maintained at its own predetermined uniform temperature. While only three loops and two zones are shown, any number of combinations of loops and zone can be used as long as each loop has its own duct and corresponding heat element and fan.

[0039] Although the present invention has been described with reference to certain preferred embodiments thereof, other versions are readily apparent to those of ordinary skill in the preferred embodiments contained herein.

What is claimed is:
1. A heated air curtain warmer comprising:
   a plurality of loops, associated with said at least one food storage container, with each loop having a duct, a corresponding heating element and a corresponding fan wherein each fan provides a heated airflow wherein a portion of each airflow provided by each said fan is divided between a portion of each airflow that provides an air curtain and a portion of the airflow that flows over and around the stored products that are to be heated is responsible for maintaining a uniform temperature of each at least one food storage container;
   a control system to control the temperature of each loop independent of but in concert with other loops to provide a predetermined and uniform temperature of each at least on food storage container.
2. The heated air curtain warmer of claim 1 wherein each at least one food storage container has a single opening accessible through an air curtain by which the stored food in each at least one food storage container wherein said stored food is moved from the interior of each at least one food storage container to the exterior of said warmer.
3. The heated air curtain warmer of claim 1 wherein each at least one food storage container has at least one support surface inside each at least one food storage container to support the food items that are to be stored in each at least one food storage container.
4. The heated air curtain warmer of claim 1 wherein the number of food storage containers is two.
5. The heated air curtain warmer of claim 1 wherein the number of loops is three.

* * * * *