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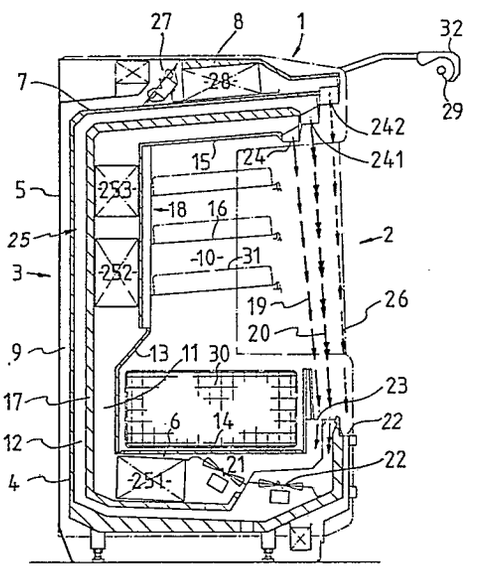
(54) Refrigerated display cabinet.

(57) A refrigerated display (1) cabinet, which has front access (2) and an air circulating cooling system (3). The circulating cooling system provides for up to three air curtains (19, 20, 26) for the front access (2), which become increasingly cooler towards the cabinet display area (10), each air curtain being independently impelled. The evaporation means (28) controlling the outermost curtain (26) is activated in response to sensors which detect the temperature and/or humidity of the ambient environment, allowing operation in an air-conditioned or non-air-conditioned environment.



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Description

Refrigerated Display Cabinet

This invention relates to a refrigerated display cabinet.

The invention particularly relates to display cabinets with front access and to the airflow which maintains such display cabinets in a cool or refrigerated condition.

The refrigeration system generally employed in such display cabinets comprises a motor-driven compressor, a condenser and an evaporator. The evaporator is traditionally in communication with a cooled chamber in which, for example, foodstuffs are displayed and stored.

In order to keep the display area cool, it is usual to provide cold air circulation over the evaporator and thereafter over the open front access to the display area providing an air curtain to insulate the display area from the ambient air temperature and to prevent entrainment of humid external air into the relatively dry air of the display. Heat transfer is further limited by the provision of second and even third air curtains, each successive air curtain further reducing the entrainment of external air. Such cabinets are sometimes termed laminar airflow cabinets.

Although laminar airflow cabinets were developed largely in the USA, the use of laminar airflow refrigeration cabinets diminished with the US energy crisis when it was found to be essential to incorporate air conditioning within stores to ensure reliable operation. At ambient humidities in excess of 55% relative humidity, the systems are generally asked to dehumidify more than they can refrigerate, and the evaporators become ice-bound, dramatically reducing their effectiveness.

In these circumstances, maintenance costs are correspondingly high.

These costs coupled with both high capital and running costs have contributed to the decline in use and sales of laminar airflow cabinets.

More recently, the employment of air conditioning, often using the heat discharged from refigeration plants. has been steadily increasing particularly in superstore developments.

Other retail outlets, however, are not always equipped for nor are retailers inclined to spend money on air conditioning, and until now there has been no cabinet which would operate efficiently in non air conditioned environments.

According to the present invention there is provided a refrigeration display cabinet having a front access and an air circulation cooling system, said cabinet comprising a casing, refrigeration means including first and second evaporating means. and impelling means for circulating the air, said air circulation having a first and second part, the first part being within the casing, passing the first evaporating means and providing an air curtain for the front access of the cabinet, the second part being outwith the casing and passing the second evaporating means and providing an air curtain between the air curtain of the first part and the ambient air.

Preferably, there are impelling means for each part of the circulation.

The second evaporating means may be activated in response to sensors whch detect the temperature and/or humidity of the ambient environment.

Preferably, air of the first part of the circulation comprises a first and a second circuit, air of the two circuits being circulated in separate channels within the cabinet, only air of the first circuit passing the first evaporating means.

Preferably, the first evaporating means includes two or more evaporators and, most preferably, three evaporators. The evaporator over which the air of the first circuit first passes after entry may have a high primary surface and low secondary surface to provide dehydration duty and the second and third evaporators may comprise staged lowering of primary surface areas with staged increase in secondary surface area to provide refrigeration duty.

Preferably, air of each circuit is discharged as a separate but adjacent air curtain.

Preferably, the air of the first circuit provides an inner air curtain and the air of the second circuit provides an outer insulating air curtain for it.

Preferably, air of the second part of the air circulation passes down the lower front of and underneath the casing and rises in a channel which backs and tops the casing and which includes the second evaporating means; most preferably, the channel terminates in a discharge honeycomb for an air curtain.

The channel may be formed by the close apposition of a wall to the rear of the casing, or may be formed by providing a cover to the casing, which cover includes a canopy extension over the top of the casing.

Preferably, the second evaporating means and the impelling means for the second part are positioned at a high level in the channel.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawing, which is a sectional elevation through a refrigerated display cabinet according to the present invention.

Referring to the drawing, there is provided a refrigerated display cabinet 1 having an open front access 2 and an air circulation cooling system (shown generally at 3). The cabinet 1 comprises a casing 4 with rear portion 5, trunk area 6 and canopy 7, and a cover 8 for said casing 4, said cover 8 being spaced from the rear portion 5 and canopy 7 so as to form a rear cavity 9 and add height to the canopy 7.

The interior of the cabinet contains a plurality of shelf units 16 with perspex dividers 31 and a free standing wire divider 30 positioned on the base tray 14. A number of extended lamps 29 are received by parabolic reflectors 32 which are also provided.

The cabinet 1 is constructed to provide two circulations of air, an interior circulation within the casing 4, and an exterior circulation around the

outside of the casing 4 but within the cavity 9 of the cover 8, these circulations being represented in the drawing by solid and dashed arrows respectively.

The interior circulation has two circuits, a primary and a secondary, represented by single and double arrow-heads respectively.

The casing 4 bounds an internal space divided into a display area 10 and channels 11, 12 for air of the first and second circuits respectively; the walls of the first channel 11 bound the display area 10, the walls being in the form of a rear screen 13, base tray 14 and top screen 15. The display area 10 has the open front 2 for access by staff and shoppers to the foodstuffs displayed on the base tray 14 in the trunk area 6 or supported on shelves 16 attached to the rear screen 13.

The channels 11, 12 for air of the primary and secondary circuits run parallel to each other within the casing 4, with the channel 11 of the primary circuit being of slightly shorter length and lying innermost to the other. The channels 11, 12 are separated by a dividing wall 17 extending from a position beneath the base tray 14 to run parallel to, and equidistant from, the rear screen 13 of the display area 10 and the back wall of the casing 4, to terminate at the front of the canopy 7.

The cabinet 7 also includes the refrigeration means (shown generally at 18) having evaporating means; the evaporating means for refrigeration are located within the first ie the innermost channel 11.

Air from both primary and secondary circuits is used to form air curtains 19, 20 across the open front 2 of the casing 4 thus insulating the display area 10.

Air of the primary and secondary circuits is circulated largely independent of one another by separate impelling means in the form of fans 21, 22, which draw the air curtains 19, 20 in at a duct 23, and which divide the air between the two channels 11, 12 to recirculate it around the back 5 and canopy 7 area of the casing 4 before discharging the air through discharge honeycombs 24, 241.

Within the primary channel 11 are located one or more cooling evaporators 25 of varying design, forming part of the refrigeration means 18, to both dehydrate and refrigerate the airflow in the correct proportion. After entering the duct 23, air drawn along the primary, or innermost,circuit 11 first passes over an evaporator 251 of high primary surface and low secondary surface to provide dehydration duty, thereafter the air rises behind the rear screen 13 to pass over high-level evaporators 252, 253 comprising staged lowering of the primary surface areas with staged increasing of the secondary surface areas to provide refrigeration duty.

Air drawn through the secondary, or outer, channel 12 is circulated without interruption from duct 23 to discharge honeycomb 241 and heat gained between these points is removed by passage alongside the chilled inner, or primary, air curtain 19.

Air from the exterior circulation is also used to produce an air curtain 26 and the effect of these air curtains 19, 20, 26 is to create a three-layered laminate formation across the open front 2 to limit heat gain and ingress of humid air into the food products within the display area 10, from the ambient air.

The number of air curtains required has been found to be in proportional to the temperature difference between conditions required in the display area 10 and the ambient conditions.

For the cabinet 1 shown in the drawing to operate successfully when the ambient conditions are less than 25° C and/or 55% relative humidity, the primary and secondary circuits' air curtains 19, 20 are sufficient to maintain the low temperature of the foodstuffs. However, when the ambient temperature and/or humidity exceeds these levels, two air curtains are insufficient, and the air curtain 26 of the external part of the air circulation is actuated. The external air circulation is impelled by a fan 27 which is situated at the top of the cabinet 7, between the cover 8 and the casing 4, and which draws-in the chilled spill air at the upper front 22. The air so drawn flows down and under the cabinet and rises up the rear cavity 9 to be expelled through a discharge honeycomb 242 at the front of the cabinet 1, thus forming an insulating curtain 26 to the primary and secondary circuits' air curtains 19, 20.

The air of this circulation passes an air conditioning evaporater 28 which is situated adjacent the fan 27 of this circulation and which chills and dehydrates the stream of air; this reduced humidity chilled air then insulates the primary and secondary circuits' air curtains 19, 20 from high ambient temperatures and/or humidities and prevents the icing-up of the primary circuits' evaporators 251, 252, 253.

Providing the cabinet 1 with its own air conditioning system allows the cabinet 1 to operate in stores and areas where before total store or total area air conditioning would have been required.

In certain conditions cabinets 1 may be required to have the air-conditioning circulation system running continuously, or else it may be more efficient to have only a single air curtain (19 or 20) from the first part of the circulation and the continuously actuated air-conditioning circulation of the second part.

Claims

1. A refrigerated display cabinet having front access and an air circulation cooling system, said cabinet comprising a casing, refrigeration means including first and second evaporating means, and impelling means for circulating the air, said air circulation having a first and a second part, the first part being within the casing, passing the first evaporating means and providing an air curtain for the front access of the cabinet, the second part being outwith the casing and passing the second evaporating means and providing an air curtain between the air curtain of the first part and the ambient air.

2. A refrigerated display cabinet according to Claim 1, in which the impelling means comprises a separate impeller for each part of the circulation.

3. A refrigerated display cabinet according to

Claim 1 or Claim 2, in which the second evaporating means is activated in response to sensors which detect the temperature and/or humidity of the ambient environment allowing operation in an air conditioned or non-air conditioned environment.

4. A refrigerated display cabinet according to any preceding Claim, in which air of the first part of the circulation comprises a first and a second circuit, air of the two circuits being circulated in separate channels within the cabinet, only air of the first circuit passing the first evaporating means.

5. A refrigerated display cabinet according to Claim 4, in which the first evaporating means comprises at least two evaporators arranged in series in the first air circuit, the first evaporator over which the air of the first circuit first passes after entry having a high primary surface and low secondary surface to provide dehydration duty and the second evaporator providing a reduced primary surface area and increased secondary surface area to provide refrigeration duty.

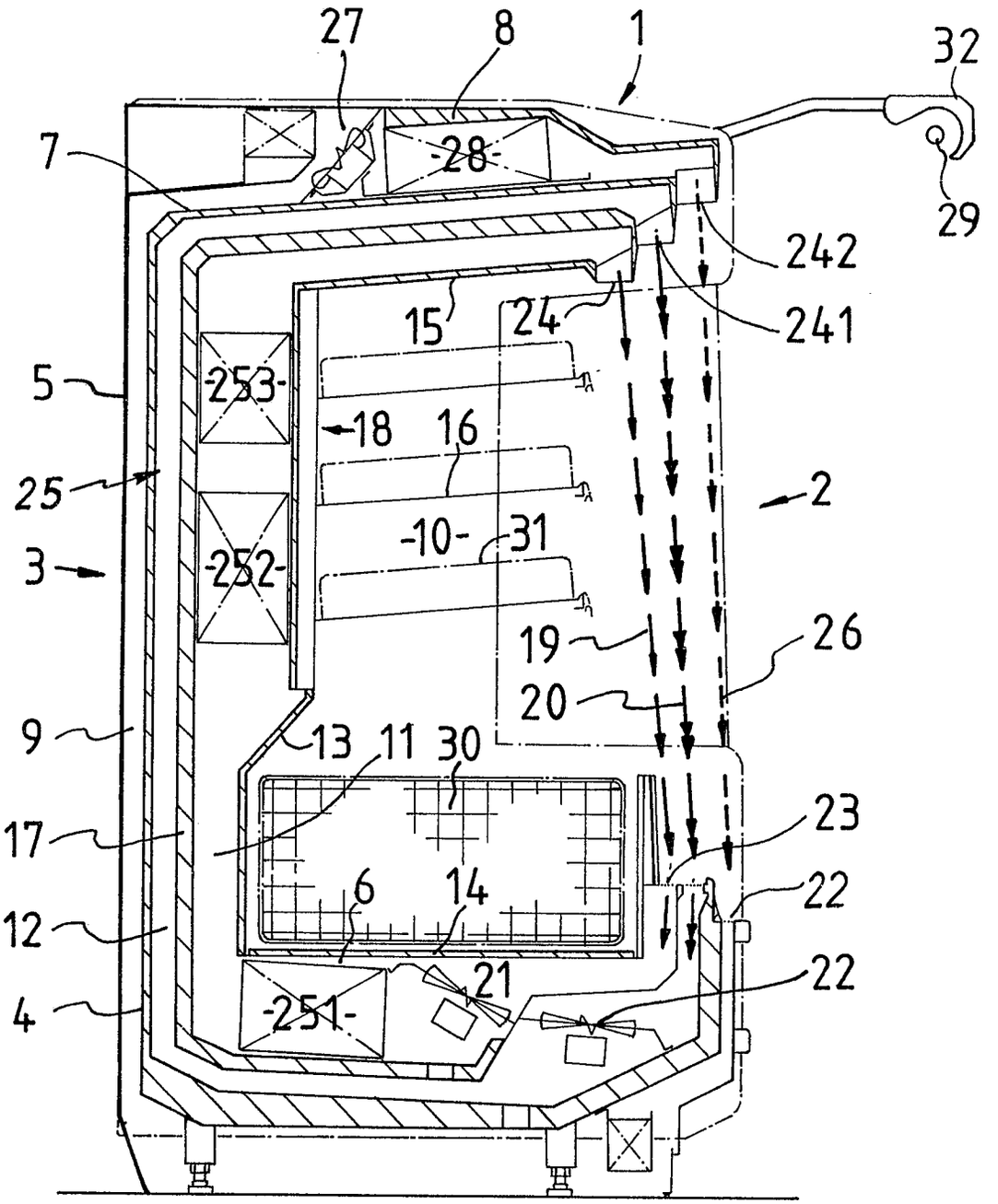
6. A refrigerated display cabinet according to Claim 5, in which the first evaporating means comprises three evaporators arranged in series in the first air circuit, the primary surface areas of the evaporators reducing in stages and the secondary surface areas increasing in stages.

7. A refrigerated display cabinet according to Claims 4 to 6, in which the air of the first circuit provides an inner air curtain and the air of the second circuit provides an outer insulating curtain for the inner air curtain.

8. A refrigerated display cabinet according to any preceding claim in which air of the second part of the air circulation passes down the lower front of and under-neath the casing and rises in a channel which backs and tops the casing which includes the second evaporating means.

9. A refrigerated display cabinet according to Claim 8, in which part of said channel may be formed alternatively by the close apposition of the rear of the casing to an upright support or by providing a cover to the casing, and part of said channel is formed by a canopy extension over the top of the casing.

10. A refrigerated display cabinet according to any preceding claim, in which the second evaporating means and the impelling means for the second part of the air circulation are positioned above the cabinet.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EUROPEAN SEARCH REPORT

Application Number

EP 89 30 2988

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	US-A-3 304 736 (BRENNAN et al.) * Whole document *	1,2,8,9	A 47 F 3/04
Y		4-7,10	
Y	US-A-4 026 121 (AOKAGE et al.) * Whole document *	4-7,10	
A	DE-U-8 524 577 (TYLER REFRIGERATION GmbH) * Whole document *	3	
A	DE-A-1 501 282 (LITTON INDUSTRIES INC.)		
A	US-A-3 287 929 (BECKWITH)		
A	US-A-3 812 684 (BROWN)		
A	US-A-3 756 038 (MacMASTER et al.)		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

A 47 F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27-06-1989	SILVIS H.

CATEGORY OF CITED DOCUMENTS

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