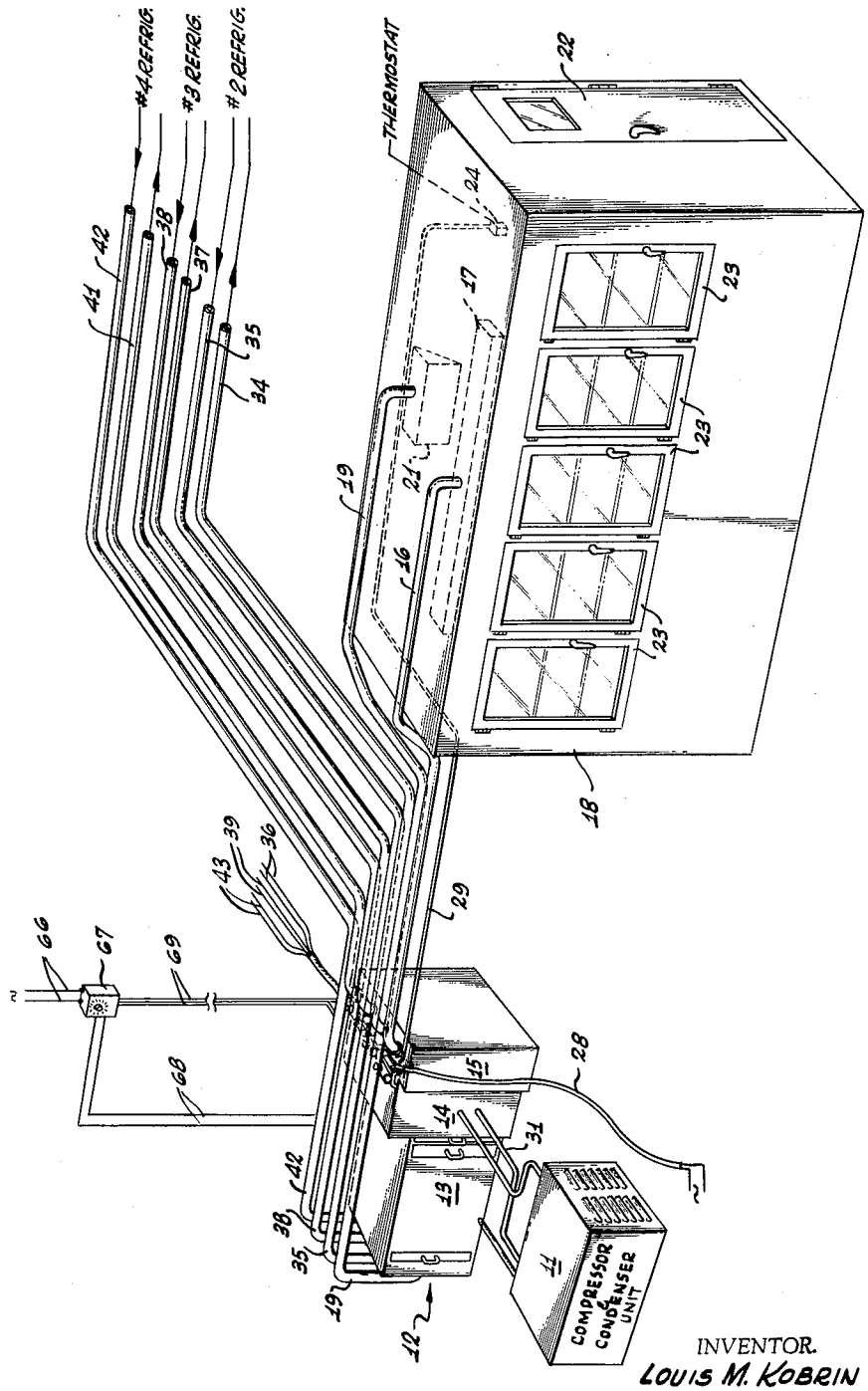
Feb. 8, 1966 L. M. KOBRIN 3,233,422

REFRIGERATION SYSTEM

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Fig. 1



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Fig. 2

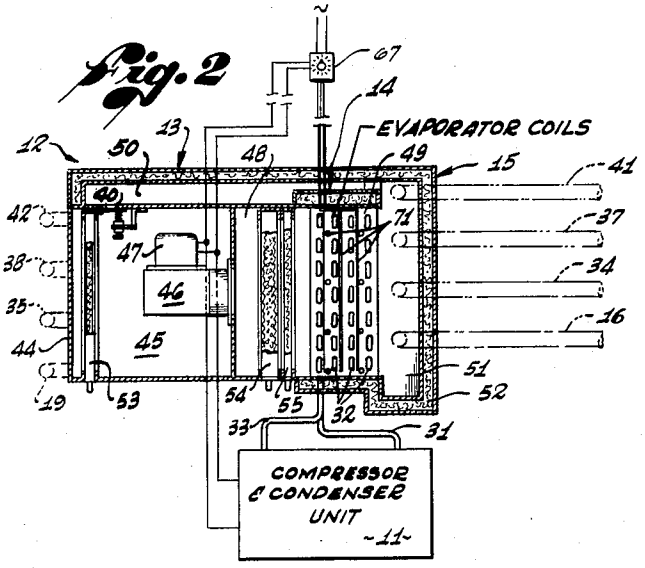


Fig. 4

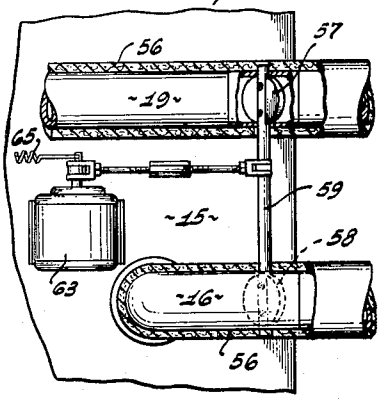
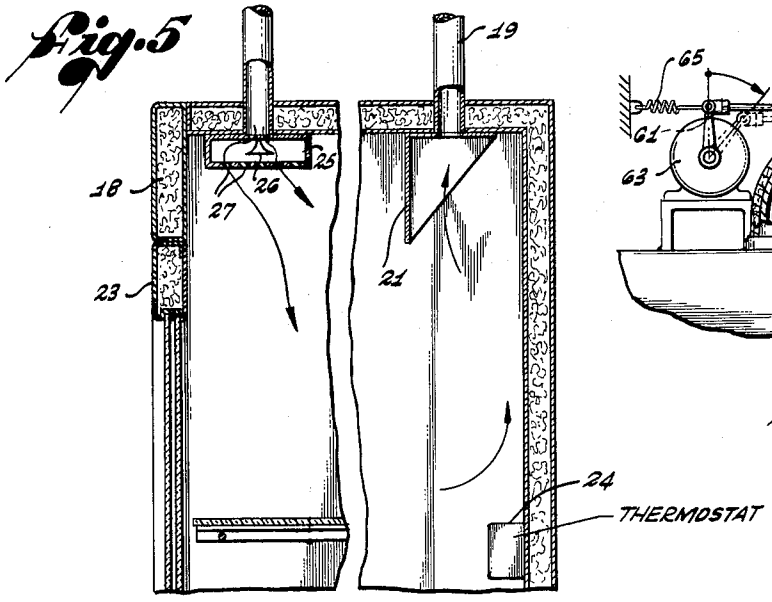


Fig. 5



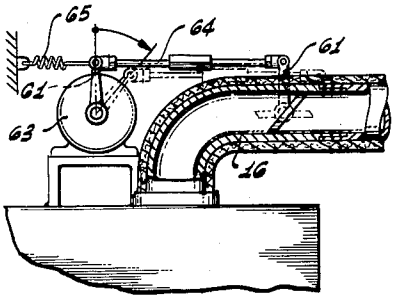


Fig. 3

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REFRIGERATION SYSTEM

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8 Claims. (Cl. 62—155)

The present invention relates to refrigeration systems, and more particularly to refrigeration systems supplying artificially cooled air to refrigerator boxes to effect cooling therein.

Conventional refrigeration systems, whether for single or multiple boxes, mount evaporator coils within the refrigerated space and feed these coils with fluid from a compressor-condenser unit outside of the refrigerated space. Particularly where the refrigerator boxes are used for the storage of food, the evaporator coils and the drain pans and associated equipment form undesirable sources of contamination. The evaporator coils may deteriorate with age; dirt accumulates on the coils; the metal surfaces of the coils may flake therefrom; and these, and the results of defrosting the coils and cleaning the coils and drain pans may not only result in undesirable odors and flavor in the stored food, but actual contamination thereof with biologically undesirable elements.

According to the present invention, the evaporator coils are located outside of the refrigerator boxes and air is cooled by passage over the coils and the clean, filtered and refrigerated air is supplied to the refrigerator boxes to maintain a refrigerating temperature therein. The air is preferably recirculated and is passed not only through mechanical filters to remove dust and other particulate material therefrom, but is also desirably passed through activated carbon or similar chemical filters to remove odors, acids, etc., from the circulating air.

Both the supply and return air lines for the refrigerator boxes are preferably damper controlled to maintain the interior refrigerated space substantially at atmospheric pressure so that upon opening of the boxes there will occur neither inrush of warm air nor outflow of cold air from the refrigerated chamber. Likewise the maintenance of the refrigerated space at atmospheric pressure prevents loss through leaks which might otherwise occur even though the box were not opened.

It will be apparent that any number of refrigerator boxes may be supplied in parallel from a single blower and evaporator coil installation, with the supply and return of the air to the individual refrigerator boxes being individually controlled by thermostats in the respective boxes.

It is therefore an object of the present invention to provide an improved refrigeration system.

Another object of this invention is the provision of an improved refrigeration system employing clean, refrigerated air for removing heat from the refrigerated space.

Another object of the invention is the provision of an improved refrigeration system employing a central evaporator outside of the refrigerated space and means for circulating air between the evaporator and the refrigerated space to effect heat transfer therebetween.

A further object of this invention is the provision of a refrigeration system in accordance with the immediately preceding object in which the supply and return lines to the refrigerated space are both damper controlled in unison to maintain substantially atmospheric pressure within the refrigerated space.

A still further object of this invention is the provision of an improved circulating air refrigeration system employing closed cycle refrigeration apparatus including evaporator coils outside of the space to be refrigerated and means for circulating air between the space to be refrigerated and the evaporator coils, in which the air is

filtered to supply clean, odorless, cold air to the refrigerator space.

Yet another object of this invention is the provision of an improved refrigeration system in accordance with the immediately preceding object in which the refrigerated space is made up of a plurality of independent refrigerator boxes to which the supply and return of cold air is individually controlled in response to sensors individual to the separate boxes.

These and other objects and features of the invention will be readily apparent to those skilled in the art from the following specification and the appended drawings, in which:

FIGURE 1 is a perspective view of a refrigeration system according to the present invention;

FIGURE 2 is a horizontal sectional view through the evaporator coil and blower portion of the refrigerator system of this invention;

FIGURE 3 is a detail side view, partially broken away, of the damper and control construction for an air-circulating conduit;

FIGURE 4 is a plan view, broken away in part, of the double damper control for the supply and return of cooling air; and

FIGURE 5 is a sectional view through a refrigerator box and the inlet and outlet for the cooling air circulating therethrough.

Referring first to the system representation of FIGURE 1, a conventional compressor and condenser unit for a closed cycle refrigeration apparatus is shown at **11**. This apparatus may conventionally use Freon or a similar refrigerant in a closed cycle by which it is compressed, condensed and stored in the unit **11** and is fed, as required, through an expansion valve to the evaporator coils of the apparatus. The blower and air cooler unit of the system is indicated generally at **12** and comprises a blower and filter section **13**, an evaporator and heat exchange section **14**, and a cold air header section **15**.

A cold air supply conduit **16** leads from the header **15** to a diffusing and distributing head **17** within a refrigerator box **18**. A return air conduit **19** leads from a baffling outlet **21** within the refrigerator box to the inlet of the blower and filter section **13**, passing in part in parallel with the supply conduit **16** for the more easy common control of dampers in the supply and return conduits, as will be explained hereinafter more particularly in connection with FIGURES 3 and 4.

The refrigerator box **18** may be of either or both a walk-in or reach-in access type, and has been illustrated in FIGURE 1 as having a walk-in access door **22** and a plurality of reach-in access windows or doors **23**. A thermostat or other sensing transducer **24** is located within the refrigerator box **18** and is connected through control wires **29** and electrical supply lines **28** to control the dampers in the air circulating conduits in accordance with the cooling requirements of the refrigerator box.

Referring now to both FIGURES 1 and 5, the distributing and diffusing head **17** provides an elongated chamber **25** which may desirably extend along the major axis of the refrigerator box at the side thereof containing the reach-in access openings. A deflector **26** is located immediately beneath the conduit **16** and the bottom of the head **17** is provided with angularly directed diffuser openings **27** through which the cold air is inserted into the refrigerated space within the box **18**. The flow of cold air may desirably be directed generally downwardly and inwardly to provide a curtain of cold air over the access opening against entrance of warm air, while inhibiting loss of cold air through the opening. The cold air circulates within the refrigerator box **18** and is returned to the blower and cooling unit **12** through the

conduit 19, the entrance to which is baffled at 21 to inhibit direct flow of air between the inlet and outlet.

The compressor and condenser unit 11 is of conventional construction to include an electric motor driven compressor, a heat exchanging condenser where the heat of compression is removed and the refrigerant liquefied, and a receiver where the liquid refrigerant is stored. The liquid refrigerant is then fed, as by piping 31, through an expansion valve (not shown) to evaporator coils 32 (FIGURE 2) within the heat exchange, air cooling section 14. The expanded, gaseous refrigerant is withdrawn from the evaporator coils by tubing 33 back to the compressor in unit 11. The compressor-condenser unit is under the control of a conventional low-pressure transducer which operates the unit only when a refrigeration cycle is called for by the existing load on the apparatus. The closed cycle refrigeration apparatus is therefore self-contained and self-controlled to operate to maintain the evaporator coils 32 always at refrigerating temperature.

Any desired number of refrigerator boxes may be supplied from the unit 12, and FIGURE 1 shows cold air supply conduit 34 and return air conduit 35, as well as thermostat control wires 36 for a second refrigerator box. Also, supply and return conduits 37, 38 and thermostat control wires 39 for a third refrigerator box, and supply and return conduits 41, 42 and thermostat control wires 43 for a fourth refrigerator box.

The blower and filtering section 13 comprises an inlet header 44 into which lead the return air conduits 19, 35, 38 and 42. The inlet header 44 supplies a large chamber 45 within which is mounted an air blower 46 driven by an electric motor 47. The blower 46 takes its inlet from the chamber 45 and feeds into a forward chamber 48 which connects with a heat transfer chamber 49 in the section 14 in which are disposed the evaporator coils 32. The cold air from the heat exchange chamber 49 passes into an outlet chamber or header 51 in the section 15 which is connected to the cold air supply pipes 16, 34, 37 and 41. A suitable insulating wall 52 may surround the sections 14, 15 to prevent heat transfer therethrough. A by-pass passage 50 extends between the outlet chamber 51 and the blower chamber 45. Its opening into the blower chamber is normally closed by a spring-loaded flapper valve 40 which limits the pressure built up in chamber 51 during periods of little or no demand for refrigerating air.

The air circulating between the evaporator coils 32 and the interior of the refrigerator boxes, such as 18, is desirably both mechanically and chemically filtered to supply clean, odorless air to the refrigerator boxes. For this purpose a convenient arrangement is a combination of fiberglass or other mechanical filters with an activated charcoal filter to remove odors, acids, etc., from the circulating air. These filters may be arranged serially in the air circuit in various positions according to the operating conditions peculiar to a given installation, and in the embodiment shown in the drawing, provide a readily removable and replaceable mechanical fiberglass filter 53 adjacent the inlet end of the inlet header 44 whereby the return air is mechanically filtered before passing through the blower 46 to the chamber 48. In the chamber 48 is disposed an activated charcoal filter 54 which is also readily removable and replaceable in conventional manner, and this may be immediately followed by another mechanical fiberglass filter 55 so that only clean odorless air will be fed over the evaporator coils 32 to the outlet header 51 and the supply pipes 19, 34, 37 and 41. In another arrangement, the filter 55 can be moved to a position upstream of the evaporator coils 32, that is, between the chambers 49 and 51, or a fourth mechanical filter might be placed at this location to insure that nothing from the evaporator coils 32 can be entrained in the circulating air. It will be seen that the filters are subject to many arrangements and may be readily varied in number and location to meet the needs of an individual installation. In general, it is desired to provide for both mechanical and chemical cleaning of the circulating air so that clean, odorless, refrigerated air will be supplied to the refrigerator boxes.

Referring now to FIGURE 4, the supply conduit 16 and return conduit 19 are shown in parallel, adjacent relation above the section 15 of the blower and cooling unit 12. These conduits may be of any desired material—conveniently a plastic tubing about which is disposed an insulating sheath or coating 56. The conduit 19 is provided with a damper 57 and the conduit 16 with a damper 58, the dampers 57 and 58 being mounted internally of the conduits and rigidly secured to a common shaft 59. A crank 61 is rigidly secured to the shaft 59 and a crank 62 is rigidly secured to the shaft of an electric motor 63 which may be of the rotating solenoid type. A rod 64 interconnects the crank arms 61, 62 to effect rotation of the dampers 57 and 58. The electric motor 63 may operate the dampers into their open, dotted-line position, as shown in FIGURE 3, and the parts are conveniently returned to the closed damper position, shown in full line in FIGURES 4 and 5, by a return spring 65. The motor 63 is controlled by the thermostat 24 from the power supply lines 28 and, when energized to call for cooling, moves the dampers 57, 58 into their open, dotted-line position of FIGURE 3. When the cooling demand is satisfied, the energization of motor 63 is interrupted and the dampers are closed under the bias of spring 65.

Provision is made for the periodic defrosting of the evaporator coils 32. A supply source is indicated at 66 leading to a clock switch 67 of the double-throw type and having normally closed contacts connecting the supply 66 to the lines 68 to the motor 47 of blower 46 and also to the motor of the compressor-condenser unit 11. The clock switch 67 also has a set of normally open contacts connecting the supply to lines 69 leading to strip or rod heaters 71 intermeshed with evaporator coils 32. The clock 67 is adjusted to periodically cut off the supply of power to both the blower and compressor motors, and at the same time, energize the heating units 71 to quickly raise the temperature of the evaporator coils 32 to melt the frost and ice therefrom. The condensate from the coils 32 will be received in the usual drain pan and outflow pipe (not shown). After another predetermined interval sufficient to effect removal of all frost from the evaporator coils, the clock switch 67 will interrupt the supply of heat to the units 71 by opening circuit 69 and will close the normally closed contacts to energize the supply line 68 to the blower and compressor motors. The motor 47 will remain energized to drive the blower 46 continuously except during the defrosting cycle, but the compressor motor in unit 11 will be under the conventional low-pressure control therein.

The operation of the refrigeration system according to the present invention will be readily apparent from the preceding description. The blower 46 runs continuously during normal operation to supply a pressure differential between the outlet header 51 and the inlet header 44. The compressor in unit 11 will independently operate on and off from its control transducer to maintain a supply of refrigerant liquid to the expansion valve and evaporator coils 32. Clean, filtered, refrigerated air will be supplied to the refrigerator boxes, like box 18, only when called for by their individual thermostats. Upon the closing of a thermostat calling for cooling, the associated pair of control lines 29, 36, 39 and 43 will energize its controlled motor 63 to move the dampers 57, 58 in the return and supply lines, respectively, of the refrigerator box calling for cooling, into open position whereupon cold, filtered, clean air will flow from header 51 through the appropriate supply pipe 16, 34, 37 and 41 to the refrigerator box calling for cooling. The air will circulate through the box and return through the associated return conduit 19, 35, 38, 42, into the inlet header 44, where it will pass through mechanical cleaning filter 53, blower 46, activated char-

coal filter 54, and mechanical filter 55, into chamber 49 where it will be cooled by heat transfer to the evaporator coils 32 and again enter the outlet header chamber 51 as clean, filtered, refrigerated air. The above operation continues to any or all of the refrigerator boxes supplied by the system as cooling is called for therein. When the thermostat of any refrigerator box is satisfied, it will deenergize its associated motor 63 to permit dampers 57, 58 to close and cut off the circulation of air through that refrigerator box.

After the expiration of a predetermined time, as determined by the clock switch 67, for example, eight hours, the double-throw contacts therein operate to open the circuit through lines 68 to deenergize the blower and compressor motors. At the same time, the normally open contacts are closed to energize the lines 69 to the heating units 71 which quickly raise the evaporator coils 32 above the melting point of the frost and ice thereon. After another time interval at which defrosting will be completed, the contact action reverses to cut off the heaters 71 and reenergize the line 68 to the blower and compressor motors.

With the disclosed concurrent operation of dampers 57 and 58, it will be apparent that the air within the refrigerator boxes 18 will always be at substantially atmospheric pressure, whether or not air is circulating therethrough. This means that there is little tendency for leakage to occur in either direction between the warm outside air and the refrigerated air in the refrigerator box, and likewise when a door 22 or window or door 23 is opened, there is no inrush of warm air nor outflow of cold air from the refrigerator box. The diffuser head 28 directs a curtain of air downwardly and inwardly over the reach-in access opening, and a similar air curtain could be placed in front of a walk-in opening into a refrigerator box.

It will therefore be seen that the refrigeration system of this invention provides for the centralized, individually-controlled supply of clean, odorless, filtered cooling air to the spaces being refrigerated to inhibit food contamination and the transfer of undesirable odors and flavors thereto. The stored and refrigerated food is therefore cleaner and purer and less likely to be tainted by undesirable odors or flavors in its refrigerator storage.

While certain preferred embodiments of the invention have been specifically illustrated and described herein, it will be understood that the invention is not limited thereto as many variations will be apparent to those skilled in the art and the invention is to be given its broadest interpretation within the terms of the following claims.

I claim:

1. A refrigeration system comprising: a refrigerated space; means providing access to said space for the insertion and withdrawal of articles to be refrigerated; a closed cycle refrigeration apparatus including an evaporator coil at the exterior of said refrigerated space; means including said apparatus for maintaining said coil continuously at cold, refrigerating temperature; an air supply conduit connected to said refrigerated space; an air withdrawal conduit connected to said refrigerated space; air flow inducing means for passing air across said evaporator coil to said air supply conduit; means continuously energizing said air flow inducing means; means connecting said air withdrawal conduit to the inlet to said air flow inducing means to form a closed circuit for circulating air between said evaporator coil and said refrigerated space; a temperature sensor in said refrigerated space; damper means in both said supply and withdrawal conduits; and means for concurrently controlling said damper means in the same direction in response to signals from said temperature sensor to control the supply of cold air to said refrigerated space while maintaining said space at substantially atmospheric pressure.

2. A refrigeration system comprising: a refrigerated space; means providing access to said space for the insertion and withdrawal of articles to be refrigerated; a closed cycle refrigeration apparatus including an evaporator coil at the exterior of said refrigerator space; an air supply conduit connected to said refrigerated space; an air return conduit connected to said refrigerated space; an enclosure for said evaporator coil; air flow inducing means; means connecting said air supply and return conduits, evaporator coil enclosure and air flow inducing means into a cotinuous closed circuit to pass air cooled by said evaporator coil into said refrigerated space; damper means connected into said air supply conduit to control the flow of air therethrough; damper means connected into said air return conduit to control the flow of air therethrough; a temperature sensor in said refrigerated space; and means effecting concurrent operation of both said damper means in the same direction in response to signals from said temperature sensor to concurrently control the flow of air in the same sense through both said air supply and return conduits.

3. A refrigeration system comprising: a refrigerated space; means providing access to said space for the insertion and withdrawal of articles to be refrigerated; a closed cycle refrigeration apparatus including an evaporator coil at the exterior of said refrigerator space; an air supply conduit connected to said refrigerated space; an air return conduit connected to said refrigerated space; an enclosure for said evaporator coil; air flow inducing means; means connecting said air supply and return conduits, evaporator coil enclosure and air flow inducing means into a continuous closed circuit to pass air cooled by said evaporator coil into said refrigerated space; damper means connected into said air supply conduit to control the flow of air therethrough; damper means connected into said air return conduit to control the flow of air therethrough; a temperature sensor in said refrigerated space; and means effecting concurrent operation of both said damper means in the same direction in response to signals from said temperature sensor to concurrently control the flow of air in the same sense through both said air supply and return conduits, said damper means operating means effecting concurrent, complete opening or complete closure of both said damper means to maintain the refrigerated space at substantially atmospheric pressure during both the supply and cut-off of cooling air.

4. A refrigeration system comprising: a refrigerated space; means providing access to said space for the insertion and withdrawal of articles to be refrigerated; a closed cycle refrigeration apparatus including an evaporator coil at the exterior of said refrigerated space; an air supply conduit connected into said refrigerated space; an air return conduit connected into said refrigerated space; an enclosure for said evaporator coil; air flow inducing means; means connecting said air supply and return conduits, evaporator coil enclosure and air flow inducing means into a continuous closed circuit to pass air cooled by said evaporator coil into said refrigerator space and withdraw it therefrom for recirculation; a temperature sensor in said refrigerated space; means responsive to signals from said temperature sensor for controlling the circulation of air through said continuous closed circuit path; a diffuser head located in said refrigerated space above and along the means providing access thereto to provide a curtain of air across the access opening; and means connecting said air supply conduit to said diffuser head.

5. A refrigeration system comprising: a refrigerated space; means providing access to said space for the insertion and withdrawal of articles to be refrigerated; a closed cycle refrigeration apparatus including an evaporator coil at the exterior of said refrigerated space; an air supply conduit connected into said refrigerated space; an air return conduit connected into said refrigerated space; an enclosure for said evaporator coil; air flow inducing means; means connecting said air supply and return conduits, evaporator coil enclosure and air flow inducing means into a continuous closed circuit to pass air cooled by said evaporator coil into said refrigerator space and

withdraw it therefrom for recirculation; a temperature sensor in said refrigerated space; means responsive to signals from said temperature sensor for controlling the circulation of air through said continuous closed circuit path; and activated filter means in said closed circuit path for removing odors from the air passing therethrough to supply cold, odorless air into the refrigerated space.

6. A refrigeration system comprising: a plurality of individual refrigerator boxes; means providing access into each of said boxes for the insertion and withdrawal of articles to be refrigerated therein; a closed cycle refrigeration apparatus common to said plurality of refrigerated boxes and including an evaporator coil at the exterior of said boxes; means including said apparatus for maintaining said coil continuously at cold, refrigerating temperature; an air supply conduit connected into each of said refrigerator boxes, an air return conduit connected into each of said refrigerator boxes, an enclosure for said evaporator coil, air flow inducing means associated with said enclosure to pass air across said evaporator coil and establishing a warm air inlet and a cold air outlet; means continuously energizing said air flow inducing means; means connecting all of said air supply conduits to said cold air outlet; means connecting all of said return conduits to said warm air inlet whereby to establish closed circuit circulation across said evaporator coil and through said refrigerator boxes; means individually controlling the circulation of air through each of said refrigerator boxes; temperature sensor means individual to each of said refrigerator boxes; and means connecting the sensors to the air circulation control means for their respective refrigerator boxes to individually control the supply of air to the refrigerator boxes as called for by signals from the sensors therein.

7. A refrigeration system comprising: a plurality of individual refrigerator boxes; means providing access into each of said boxes for the insertion and withdrawal of articles to be refrigerated therein; a closed cycle refrigeration apparatus common to said plurality of refrigerated boxes and including an evaporator coil at the exterior of said boxes; means including said apparatus for maintaining said coil continuously at cold, refrigerating temperature; an air supply conduit connected into each of said refrigerator boxes, an air return conduit connected into each of said refrigerator boxes, an enclosure for said evaporator coil, air flow inducing means associated with said enclosure to pass across said evaporator coil and establishing a warm air inlet and a cold air outlet; means continuously energizing said air flow inducing means; means connecting all of said air supply conduits to said cold air outlet; means connecting all of said return conduits to said warm air inlet whereby to establish closed circuit circulation across said evaporator coil and through said refrigerator boxes; damper means connected into each of said air supply and return conduits to control the air therethrough; means interconnecting the damper means for the air supply and return conduits of each

refrigerator box for concurrent operation thereof in the same direction; a temperature sensor in each of said refrigerator boxes; and means controlling the damper means for both the air supply and return conduits of a given refrigerator box in the same sense in response to the signals from the temperature sensor therein and independently of the control of the other refrigerator boxes.

8. A refrigeration system comprising: a plurality of individual refrigerator boxes; means providing access into each of said boxes for the insertion and withdrawal of articles to be refrigerated therein; a closed cycle refrigeration apparatus common to said plurality of refrigerated boxes and including an evaporator coil at the exterior of said boxes; means including said apparatus for maintaining said coil continuously at cold, refrigerating temperature; an air supply conduit connected into each of said refrigerator boxes, an air return conduit connected into each of said refrigerator boxes, an enclosure for said evaporator coil, air flow inducing means associated with said enclosure to pass across said evaporator coil and establishing a warm air inlet and a cold air outlet; means continuously energizing said air flow inducing means; means connecting all of said air supply conduits to said cold air outlet; means connecting all of said return conduits to said warm air inlet whereby to establish closed circuit circulation across said evaporator coil and through said refrigerator boxes; damper means connected into each of said air supply and return conduits to control the air therethrough; means interconnecting the damper means for the air supply and return conduits of each refrigerator box for concurrent operation thereof in the same direction; a temperature sensor in each of said refrigerator boxes; and means controlling the damper means for both the air supply and return conduits of a given refrigerator box in the same sense in response to the signals from the temperature sensor therein and independently of the control of the other refrigerator boxes, the paired damper means for a refrigerator box being connected to fully open or fully close the air supply and return conduits for that box in unison to maintain substantially atmospheric pressure within the refrigerator box at all times.

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