Sept. 29, 1936. F. R. ERBACH 2,056,041

COOLING AND VENTILATING APPARATUS

Filed May 15, 1933 3 Sheets-Sheet 1

Fig. 1.

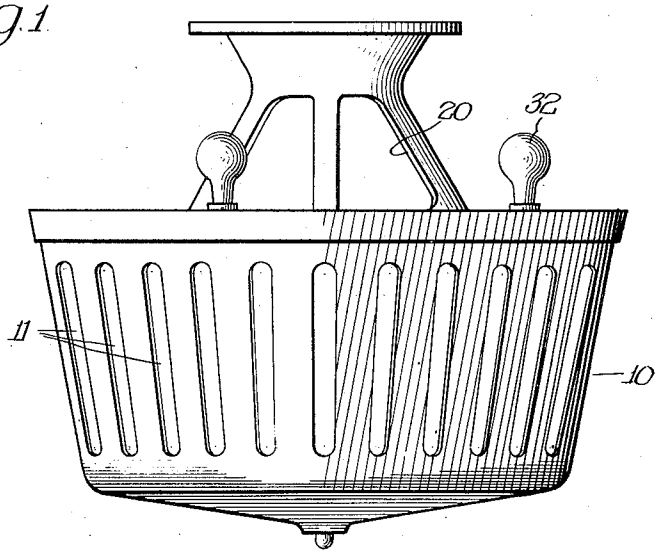
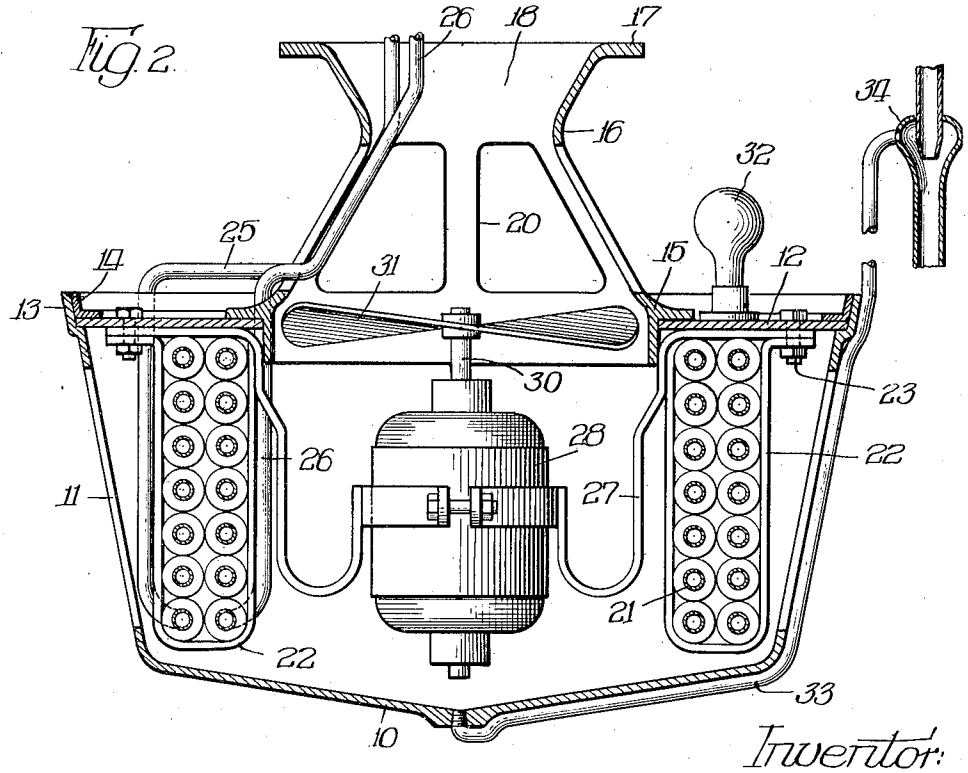


Fig. 2.



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Fig. 3.

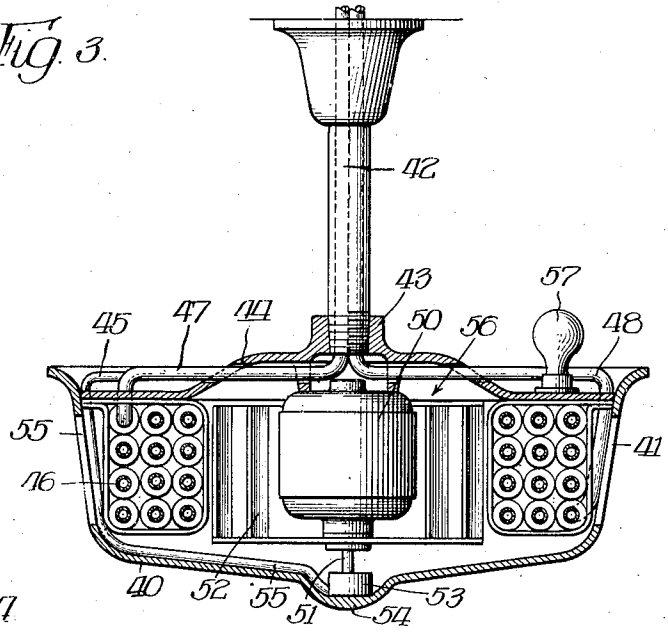


Fig. 4

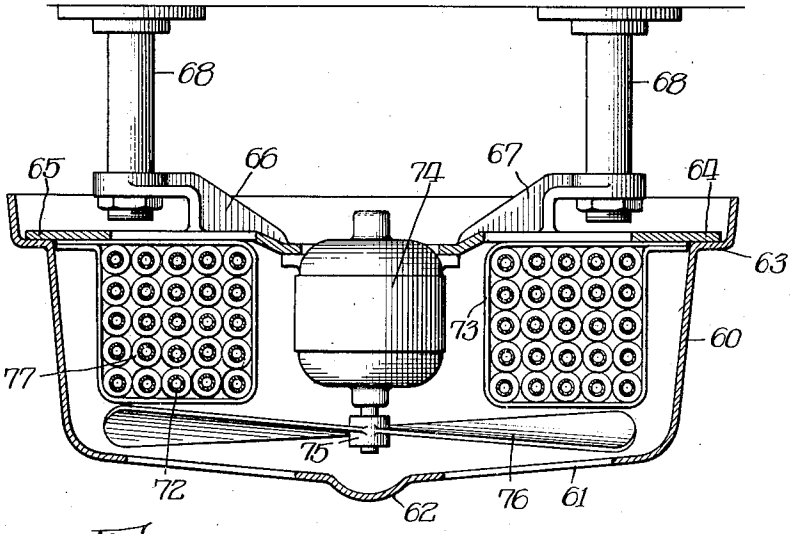
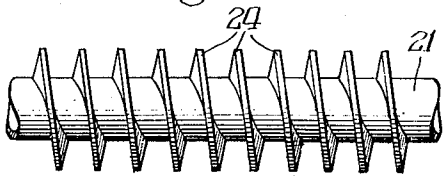


Fig. 5.



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Fig. 6

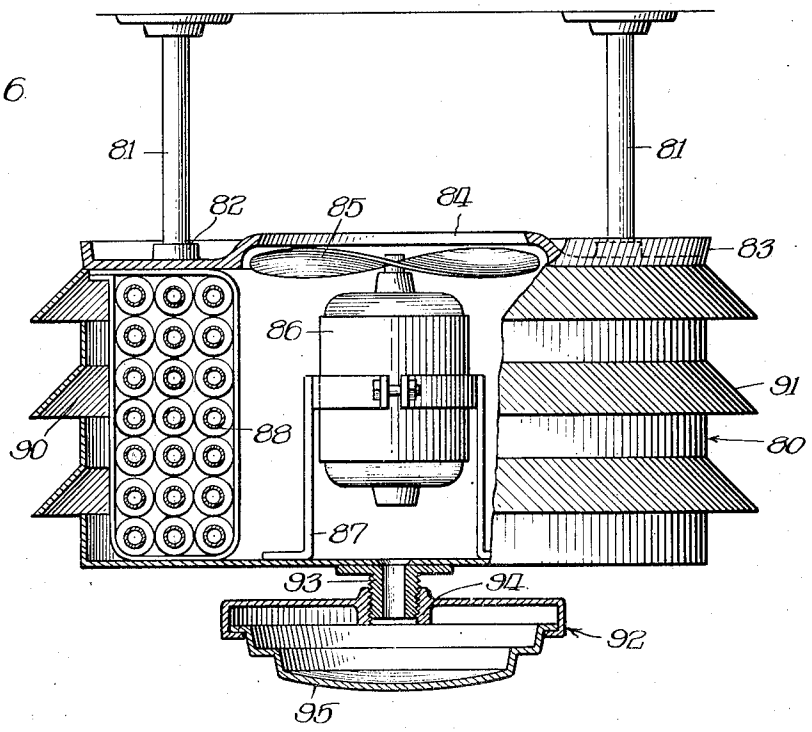
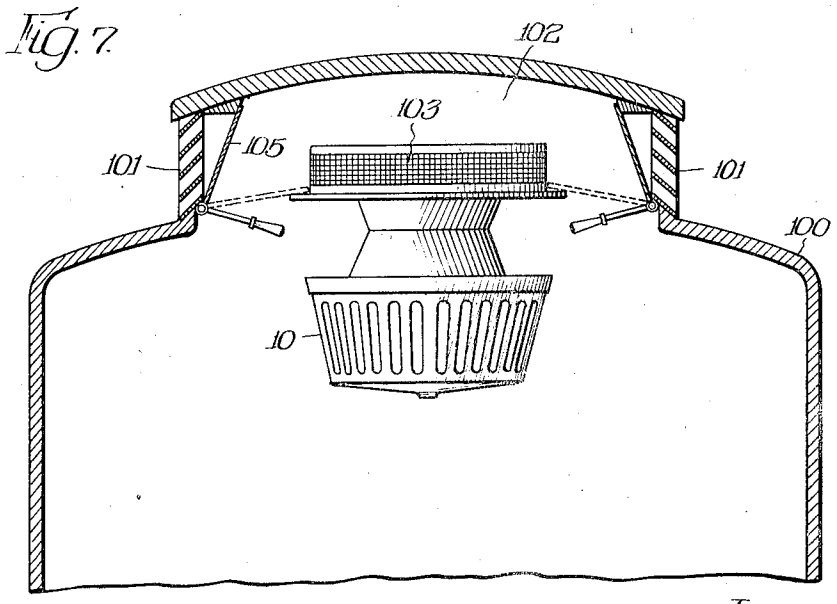


Fig. 7



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UNITED STATES PATENT OFFICE

2,056,041

COOLING AND VENTILATING APPARATUS

Fred R. Erbach, Beloit, Wis., assignor to General Refrigeration Corporation, Beloit, Wis., a corporation of Delaware

Application May 15, 1933, Serial No. 671,016

16 Claims. (Cl. 62—135)

The invention relates to improvements in apparatus for mechanically cooling and ventilating enclosures and has reference more particularly to a unit cooling device which may be suspended from the ceiling to additionally serve as lighting means.

An object of the invention is to provide a cooling unit which will forcibly direct air from the enclosure or from outside the enclosure, over a series of cooling coils contained in the unit and which may be suspended from the ceiling to additionally support lighting means.

A further object of the invention is to provide a cooling unit having self-contained means for removing condensate therefrom.

A further object is to provide a cooling unit of improved design and which in operation will draw the warm air from the top of the unit and discharge cool air radially and downwardly from the unit. By discharging the air radially a maximum frontal area is provided for the size of the device, with the result that the air may be discharged as minimum velocity. This is necessary in order to secure satisfactory dehydration of the air.

A still further object is to provide a device for mechanically cooling enclosures which will be of simple and compact construction to conserve space while providing adequate cooling surfaces, which will be economical to manufacture, and which will adequately meet all requirements of service.

With these and various other objects in view, the invention may consist of certain novel features of construction and operation, as will be more fully described and particularly pointed out in the specification, drawings and claims appended hereto.

In the drawings which illustrate an embodiment of the device and wherein like reference characters are used to designate like parts—

Figure 1 is an elevational view of the unit cooling device comprising the present invention;

Figure 2 is a vertical sectional view taken substantially through the center of the device shown in Figure 1 and showing means associated therewith for removing the condensate from the bowl;

Figure 3 is a vertical sectional view of a modified form of unit cooler showing motor operated means for removing the condensate;

Figure 4 is a vertical sectional view of another modified form of the unit cooler designed to discharge the cooled air downwardly from the unit;

Figure 5 is a detail view of a section of the finned cooling coil;

Figure 6 is an elevational view, parts being shown in section, of a modified form of unit cooler in which the bowl or container is provided with louvers for directing the air downwardly; and

Figure 7 is a vertical sectional view taken through the upper portion of an enclosure such as a passenger car showing the same equipped with a cooling and ventilating unit embodying the features of the invention.

Referring particularly to Figures 1 and 2, the invention is shown as comprising a bowl 10, of metal or other suitable material having a plurality of apertures provided in the sides of the bowl and disposed vertically when the bowl is in suspended position. A decorative design is selected for the bowl such that the apertures will not detract but instead, will enhance the appearance, and which may simulate the bowls employed in hanging lighting fixtures. The open end of the bowl is partially closed by a cover 12 in the form of a ring and which is suitably secured along its outer edge to a flange portion 13 of the bowl by means of the angle member 14 and along its inner edge to the right angle flange 15 formed on a canopy 16.

Suspending the cooling unit from the ceiling is the function of the canopy 16, which is formed with a substantially flat upper end 17 and throat 18 with apertures 20 provided therein. With the upper end 17 suitably secured to the ceiling of the enclosure it will be understood that air for the cooling unit, to be presently described, may be drawn from a conduit located within the ceiling and connecting with the atmosphere and the throat 18 in which case the air is preferably passed through filters of any suitable design or the air may be taken directly from the closure through the apertures 20. The invention contemplates that suitable closing means be provided for the apertures 20 in those instances where it is desired to draw all the air from the outside of the closure through the throat 18 of the canopy.

The bowl 20 suspended from the ceiling by the canopy 16 and ring 12, as described, provides a housing for a plurality of evaporating or cooling coils 21, arranged in concentric rows and being supported adjacent the inside periphery of the bowl by the hanger straps 22, secured by the securing means 23 to the ring 12. The cooling coils, as more particularly shown in Figure 5, are provided with a plurality of circular fins 24 rigidly secured in any well known manner to the coil for the purpose of increasing the surface of the coil subjected to contact with the air. The number of fins per unit length of coil is a matter of design, depending on the size of the unit and

volume of cooled air to be discharged per unit of time.

A supply conduit 25 extends from the ceiling, passing through the canopy and into the bowl to contact with one end of the cooling coils for the purposes of supplying the same with a refrigerant. In like manner a return conduit 26 connects with the other end of the coils to return the refrigerant to a refrigerating system, all of which is well known in the refrigerating art and need not be more particularly described.

Also supported from cover 12 through the securing means 23 and supporting straps 27 is an electric motor 28 positioned centrally of the cooling coils and having a rotor shaft 30 carrying a propeller type of fan 31. The motor is electrically connected with a source of power such as a house lighting circuit by means of conductors leading from the ceiling and extending through the canopy 16 to connect with the motor 28.

Operation of the motor to cause rotation of the propeller fan 31 will draw air from the enclosure through apertures 20 in the canopy, or air from outside the enclosure through the throat 18 connecting with the atmosphere, and will discharge the air laterally from the sides of the cooling unit through the openings 11. It will be observed that the air has thus been caused to pass the rows of cooling coils 21 to thereby contact the ccoled surface of the coils and of the fins 24 with a consequent lowering of the temperature of the air. Continued operation of the device will eventually result in a substantial reduction in the temperature as the circulation will cause the warmer air to rise to the ceiling to be drawn in through openings 20 where the same may be mixed with fresh air from outside the enclosure and again subjected to contact with the cooling coils to further reduce its temperature. In addition to providing a cooling and ventilating unit, the structure provides supporting means for a plurality of lighting units 32 electrically connected with the same lighting circuit provided for the motor 28. The cover 12 provides the support for the units and is preferably polished on its upper surface to serve as a reflector to reflect the light rays from the units 32 upwardly toward the ceiling.

After continued operation of the cooling unit, moisture in the air will collect as condensate on the interior of the bowl 10. To collect and remove the liquid from the interior of the bowl the same is provided with a sloping bottom wall converging at the lowest point substantially centrally of the bowl, which point is provided with an opening connecting with the tube 33, located exteriorly of the bowl and shaped to fit the contour of the same. The tube 33 leads to an injector designated 34, which may be operated by the overflow pipe on a water cooled type of refrigerating machine, the injector creating the necessary vacuum to withdraw the water; that is, the condensate from the bowl.

In Figure 3 the bowl 40 is provided with a plurality of apertures 41 located in the sides of the bowl and disposed substantially vertically when the bowl is suspended. In this modification, the means for suspending the bowl from the ceiling of the enclosure comprises a supporting conduit 42 suspended from the ceiling and having a threaded lower end to connect with hub 43 of the cover 44, which in turn is secured in any suitable manner to the outwardly flared upper edge 45 of the bowl.

The cover 44 additionally supports a plurality of cooling coils 46, finned as illustrated in Figure 5 and arranged in concentric rows, one end of the coil having connection with a supply conduit 47 passing through the supporting conduit 42 while the other end connects with a return conduit 48 which likewise passes through tube 42. The motor 50 supported by cover 44 and positioned centrally within the cooling coils has connected to its rotor shaft 51 a multi-blade fan 52 and a pump 53, the latter being located within a condensate receiving portion 54 in the base of the bowl 40. The pump 53 may comprise a spiral water lift pump having an outlet pipe 55 and which operates to collect the condensate and to remove the same from the bowl by pumping the liquid through the outlet pipe 55 which extends through the tubular support 52 to connect with a condensate receiving receptacle.

The operation of this form of cooling unit is substantially the same as that described with reference to the device of Figure 1, the air from the enclosure being drawn in through openings 56 in the cover and being forced by the revolutions of the multi-blade fan 52 laterally over the cooling coils 56 to be discharged from the bowl through the openings 41. This form of device also functions as a lighting unit, the cover 44 supporting the electric bulbs 57 connecting with the same source of power employed for operating the motor 50.

Figure 4 shows another modified form of cooling unit consisting of the bowl 60 provided with a plurality of apertures 61 located in the base of the bowl and which extend radially from the central portion 62. The flanged portion 63 of the bowl is secured by bolt 64 to the cover plate 65, having a plurality of openings 66 and brackets 67 for securement to the threaded ends of the depending supporting pipes 68. As in the structures previously described, the supporting pipe 68 extends from the ceiling of the enclosure and provides means permitting the passage of the supply conduit 70 and a return conduit 71 connecting with the concentrically arranged cooling coils 72 supported from the cover 65 by supporting straps 73. Also supported from the cover is an electric motor 74 having secured to its rotor shaft 75 a propeller type of fan 76, which in operation draws the warm air from the enclosure through openings 66 and discharges the same downwardly from the unit through the radial opening 61. The cooling coils 72 are finned as shown at 77 in a manner more particularly disclosed in Figure 5 with the result that the warm air prior to being discharged is caused to contact the cooled surfaces of the coils and fins, resulting in a lowering of the temperature of the air supplied to the room.

The device of Figure 6 includes a bowl or container 80 of cylindrical shape suitably suspended from the ceiling of the enclosure or from any other suitable support by the tubes or pipes 81, the depending end of the supports connecting with bosses 82 formed on the cover plate 83. The opening 84 in the cover plate is located centrally thereof for admitting air from above the container, the same being drawn in by the fan 85 operated by motor 86 supported from the bottom of the container by supports 87.

A plurality of cooling coils 88 are located within the container and arranged concentric with respect to the motor. For discharge of the air from the cooling unit the container is provided with louvers 90 which may be defined as opening in the vertical walls of the container, having

baffles 91 located above the openings for directing the air downwardly. Although these baffles are shown as exterior to the bowl housing the cooling coils, it is obvious that the baffles could be located within the bowl between the vertical walls thereof and the cooling coils. In the device shown in Figures 1 and 2 interior baffles 96 may be necessary since when the propeller fan is used in the manner shown the air has a tendency to short circuit through the cooling unit instead of passing out horizontally and then downwardly to displace the air in the room or enclosure.

In those instances where the design of the decorative bowl permits, it is contemplated that an auxiliary receptacle 92 be suspended from the bowl for the purpose of collecting the condensate. The suspending means may comprise a nipple 93 having its bore aligned with an opening in the bottom of the bowl and having a threaded exterior for securement to the threaded boss 94 on the receptacle. The receptacle shown is in two parts including a central portion 95 detachably associated with the other section so as to facilitate in the removing of the condensate collecting in the portion 95.

In Figure 7 the cooling and ventilating unit such as shown in Figures 1 and 2 is shown suspended from the ceiling of a passenger car 100 provided with a plurality of ventilating openings 101 in the roof thereof, which admit air to the compartment 102 above the ceiling of the car. The cooling unit 10, suitably suspended from the ceiling, has a filter 103 located over the passage which conducts air from the compartment to the unit. With the dampers 105 positioned in the ceiling in closed position, as shown in dotted lines, air from the outside entering the ventilating openings 101 will pass through the filter 103 by being drawn therethrough by the motor operated fan within the cooling unit and after passing over the cooling coils will be discharged laterally from the unit as has been described. Opening of the dampers 105 serves to admit air from the enclosure which will also be drawn through the filter 103 before being recirculated by the cooling unit. A partial opening of the dampers will recirculate a part of the air in the enclosure and will mix therewith atmospheric air, the total volume of air, however, being filtered prior to sending the same back to the enclosure.

In all the modifications it will be noted that the air is discharged radially from a circular structure thus presenting the maximum frontal area from which to discharge the air and which therefore may be delivered at a low velocity. This low air velocity reduces the tendency to create drafts and secures the maximum diffusion by having the air mixed thoroughly in the upper portion of the room and which gradually falls partly due to its own weight to displace the warmer air below. The present structure also properly dehydrates the air for air conditioning work. In commercial refrigerators dehydration is to be avoided and therefore a thin cooling unit section with high velocity air is employed. With this arrangement heat can be removed from the air to reduce its temperature but the cooling surfaces do not have contact with air long enough to extract the heat present in the suspended vapor, thus avoiding excessive dehydration. In air conditioning it is advisable to use a cooling unit in which the air velocity is relatively low or one which has very deep cooling surfaces when high air velocity is employed. With either one of these arrangements sufficient time is permitted for the heat to be removed from the air and in addition, for heat to be removed from the moisture in the air, to result in proper dehydration.

It is to be understood that I do not wish to be limited by the exact embodiment of the device shown, which is merely by way of illustration and not limitation, as various and other forms of the device will of course be apparent to those skilled in the art without departing from the spirit of the invention or the scope of the claims.

I claim:

1. In a cooling unit, the combination with means forming a bowl shaped receptacle, of a plurality of cooling coils supported within said receptacle, a motor operated fan positioned within said coils and operating to draw air through the open end of the receptacle and discharge the same radially through apertures provided in the receptacle, and means for removing the condensate from the bottom of the receptacle.

2. In a cooling unit, the combination with means forming a bowl shaped receptacle, of a plurality of cooling coils supported within said receptacle, a motor operated fan positioned within said coils and operating to draw air through the open end of the receptacle and discharge the same radially through apertures provided in the receptacle, said receptacle having a sloping bottom wall converging at the center thereof to collect the condensate, and means for removing the condensate.

3. In a cooling unit, the combination with means forming a bowl shaped receptacle, of a plurality of cooling coils supported within said receptacle, a motor operated fan positioned within said coils and operating to draw air through the open end of the receptacle and discharge the same through apertures provided in the receptacle, said receptacle having a sloping bottom wall converging at the center thereof to collect the condensate, and external means for drawing off said condensate.

4. In a cooling unit, the combination with a means forming a bowl shaped receptacle, of a plurality of cooling coils supported within said receptacle, a motor operated fan positioned within said coils and operating to draw air through the open end of the receptacle and discharge the same through apertures provided in the receptacle, said receptacle having a sloping bottom wall converging at the center thereof to collect the condensate, and suction means for drawing off said condensate.

5. In a cooling unit, the combination with means forming a bowl shaped receptacle, of a plurality of cooling coils supported within said receptacle, a motor operated fan positioned within said coils and operating to draw air through the open end of the receptacle and discharge the same through apertures provided in the receptacle, said receptacle having a sloping bottom wall converging at the center to collect the condensate, and means operatively connecting with the fan for removing the condensate.

6. In a cooling unit, the combination with a receptacle forming a bowl having apertures therein, of a plurality of concentrically arranged cooling coils supported within the bowl, a motor positioned within the coils, a fan operated by the motor to draw air through the open end of the bowl and discharge the same through the apertures, said bowl having a condensate collecting portion in its bottom wall, and means operated

by the motor for removing the collected condensate.

7. In a cooling unit, the combination with a receptacle forming a bowl having apertures therein, of a plurality of concentrically arranged cooling coils supported within the bowl, a motor positioned within the coils, a fan operated by the motor to draw air through the open end of the bowl and discharge the same through the apertures, said bowl having a condensate collecting portion in its bottom wall, and a water pump operated by the motor and located in the condensate collecting portion for removing the collected condensate.

8. A cooling and ventilating unit comprising a receptacle forming a bowl, means suspending said bowl from a support with its open end directly upward, a plurality of cooling coils supported within the bowl, a motor operated fan positioned within the bowl and centrally of the coils, said bowl having apertures therein, and said fan operating to draw the air from the open end and discharge the same through the apertures radially of the bowl.

9. A cooling and ventilating unit comprising a receptacle forming a bowl, tubular means suspending said bowl from a support with its open end directed upward, a plurality of cooling coils supported within the bowl, a motor operated fan positioned within the bowl and centrally of the coils, a supply pipe extending through the tubular means and connecting with the coils to supply the same with a refrigerant, a return conduit connecting with the other end of the coils and also extending through the tubular means, and said bowl having apertures whereby the fan operates to draw warm air through the upwardly directed opening and to discharge cooled air through the apertures.

10. In a cooling unit, the combination with a receptacle providing a bowl having its opening directed upwardly, of a plurality of cooling coils supported within the bowl, a motor operated fan positioned within the coils and operating to draw air through the opening in the bowl and discharge same radially from the sides of the bowl, and baffles associate with the apertures for directing the discharged air downwardly from the bowl.

11. In a cooling unit, the combination with a container having its opening directed upwardly, of a plurality of cooling coils supported within the container, a motor operated fan positioned within the coils and operating to draw air through the opening in the container and discharge the same laterally through apertures provided in the sides of the container, and an auxiliary receptacle suspended from the container for collecting the condensate from the same, said receptacle being removable.

12. In a cooling unit, the combination with a suspended bowl with its opening directed upwardly, of a plurality of cooling coils supported within the container, a motor operated fan positioned within the coils and operating to draw air through the opening in the container, and discharge the same laterally through apertures provided in the sides of the container, said container having a sloping bottom wall converging at the center thereof, and tubular means suspending an auxiliary receptacle from said center for collecting the condensate from the container.

13. A cooling and ventilating unit including a bowl shaped receptacle providing a container, a plurality of coils in said container, means suspending said container from the ceiling of the enclosure and providing a passage for conducting air outside the enclosure to the container, and a fan in the container for discharging the air admitted thereto through apertures provided in the container.

14. A cooling and ventilating unit including a bowl shaped receptacle providing a container, a plurality of coils in said container, means suspending said container from the ceiling of the enclosure and providing a passage for conducting air outside the enclosure to the container, and a fan in the container for discharging the air admitted thereto through apertures provided in the container, said ceiling having closable outlet means for the air in the enclosure whereby the same may be drawn through said passage in admixture with atmospheric air and recirculated.

15. In a cooling unit, the combination with means forming a bowl-shaped receptacle, of a plurality of concentrically arranged cooling coils supported within said receptacle, said receptacle having an opening therein and a plurality of apertures in the circular wall thereof, a motor positioned within the receptacle substantially centrally of the coils, a fan operatively connecting with said motor for drawing air through the opening and for passing the same over the coils to discharge the air through the apertures radially of the receptacle, and louvers associated with said apertures for directing the discharged air in a direction away from the opening in the receptacle whereby recirculation of the cooled air is prevented.

16. A cooling unit, in combination, a receptacle presenting a maximum frontal area for the size of the device, a plurality of substantially circular cooling coils supported within said receptacle, a motor positioned within said coils, said receptacle having an opening directed upwardly and a plurality of apertures formed in the walls thereof, said receptacle also having a base opposite said opening for collecting condensate from the cooling coils for discharge from the receptacle, and a fan operated by said motor for drawing air through said opening and discharging the same at a low velocity from the apertures.

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