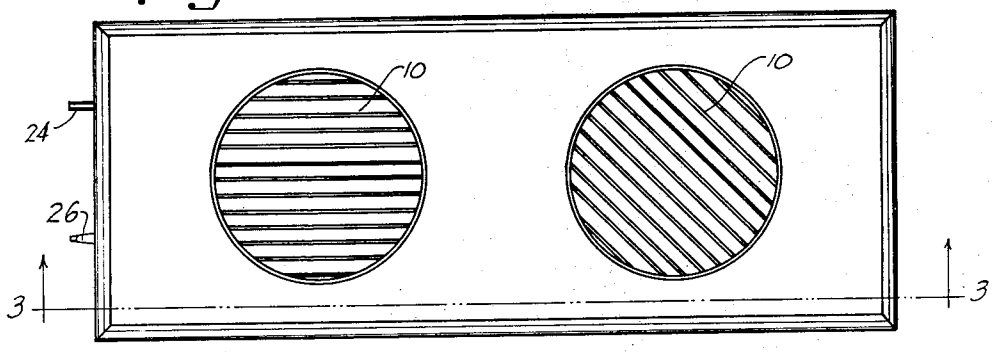
Dec. 11, 1934. A. J. R. HOUSTON 1,984,135

AIR CONDITIONING APPARATUS

Filed Sept. 13, 1933 4 Sheets-Sheet 1

Fig. 1.



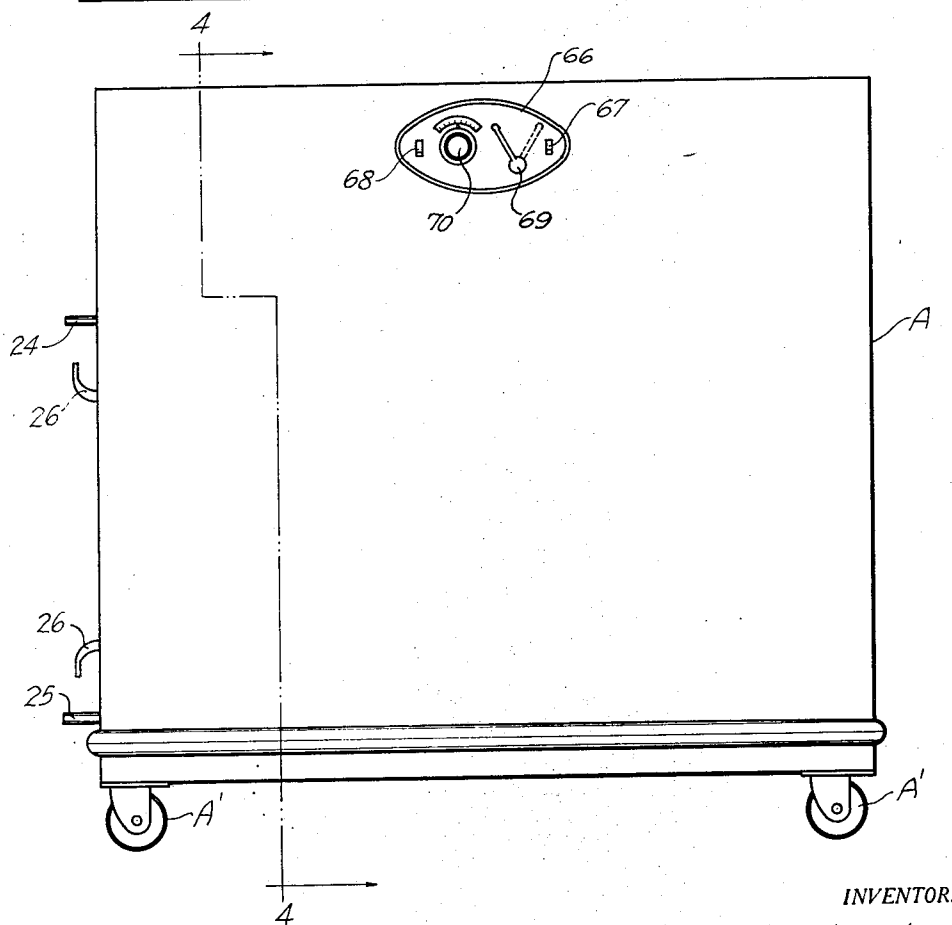


Fig. 2.

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AIR CONDITIONING APPARATUS

Filed Sept. 13, 1933 4 Sheets-Sheet 2

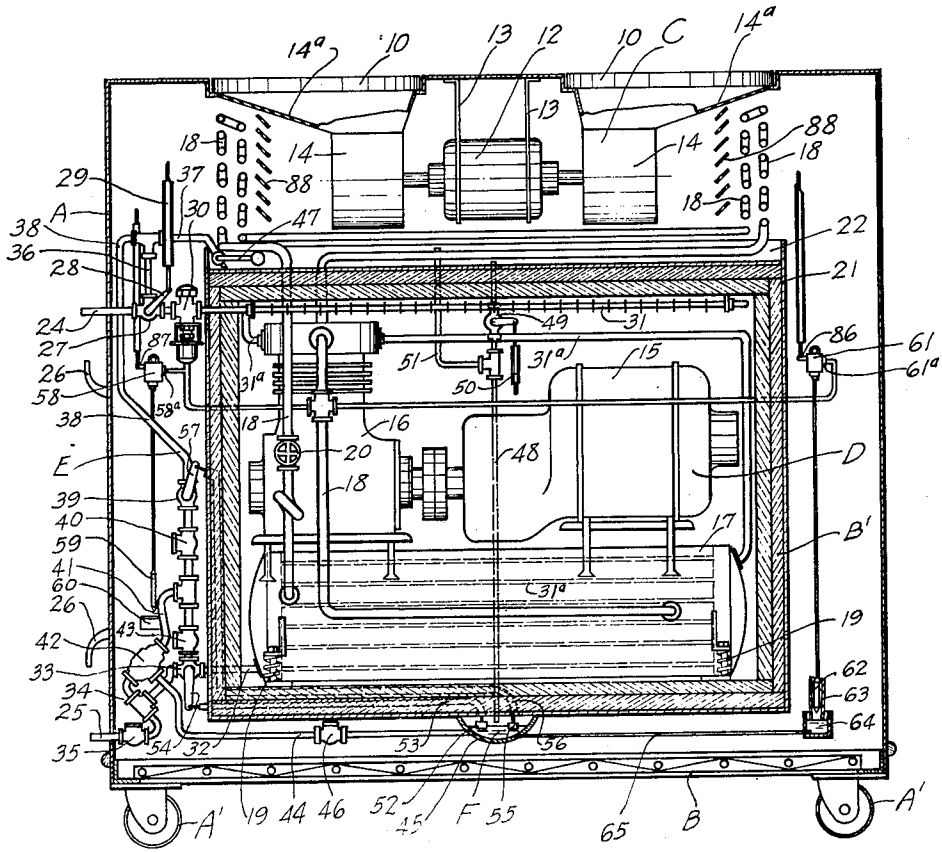


Fig. 3.

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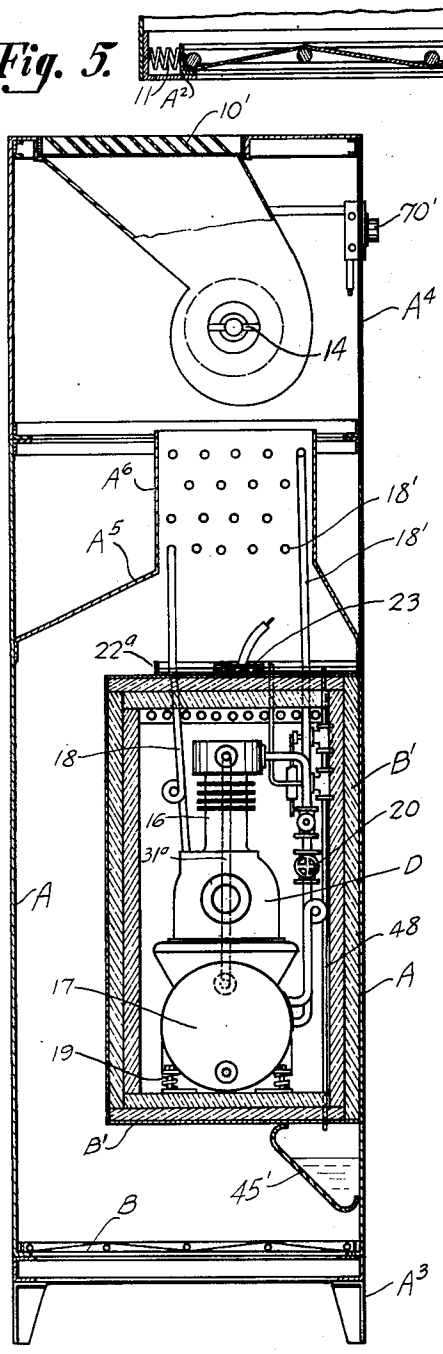
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AIR CONDITIONING APPARATUS

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Fig. 5.



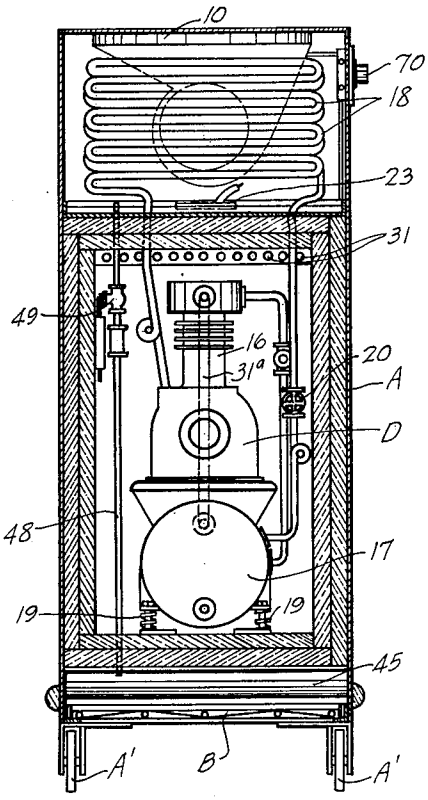


Fig. 4.

Fig. 6.

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AIR CONDITIONING APPARATUS

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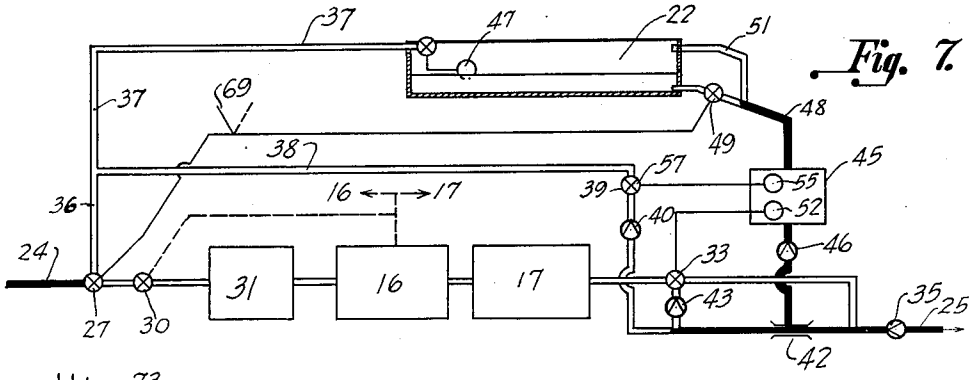


Fig. 7.

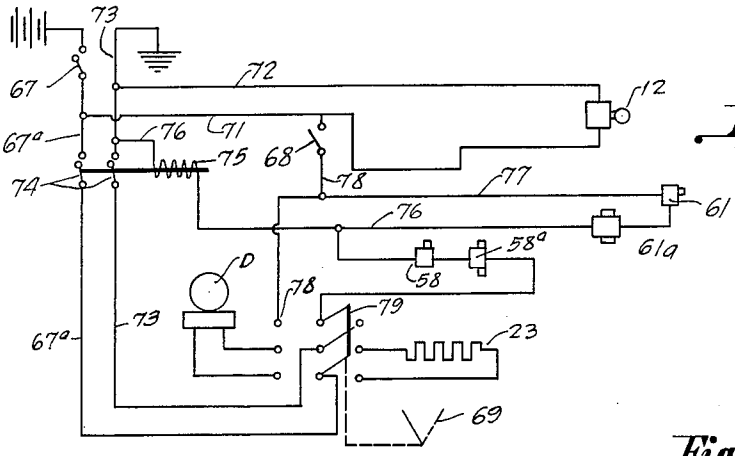


Fig. 8.

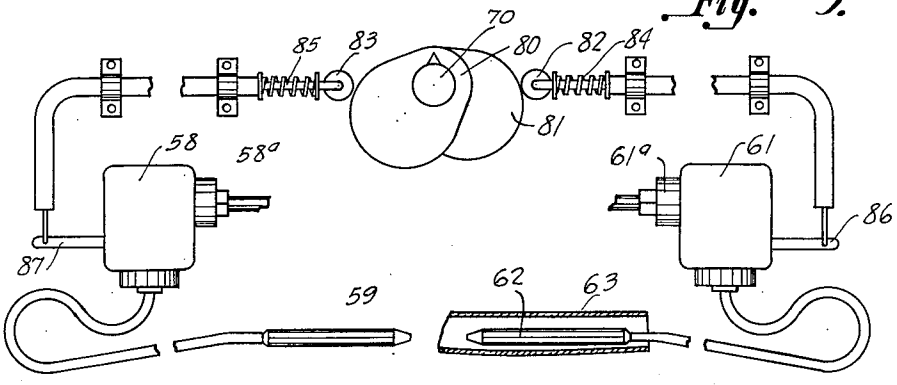


Fig. 9.

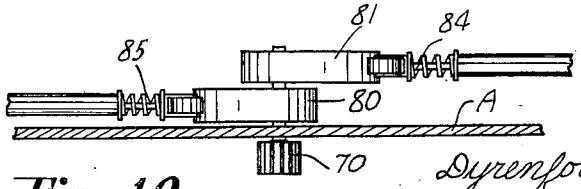


Fig. 10.

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UNITED STATES PATENT OFFICE

1,984,135

AIR CONDITIONING APPARATUS

Albert J. R. Houston, Omaha, Nebr.

Application September 13, 1933, Serial No. 689,332

14 Claims. (Cl. 257—9)

This invention relates to air conditioning apparatus. An object of the invention is to provide air conditioning apparatus in simple and compact form which may be manufactured as a unit in a factory and shipped directly to the user without requiring skilled labor for installation. The machine may be constructed as a single unit with all the work of assembly, charging, and testing, done at the factory, so that the apparatus may be marketed by merchandising methods and the work of installation made as simple as possible. Another object is to provide air conditioning apparatus which can be used as a humidifier in the winter. Another object of the apparatus is to control the atmosphere in an enclosed space, automatically maintaining the condition of the air at the point of optimum effect as to temperature and humidity, producing satisfactory air movement, and filtering out impurities. Other objects and advantages will appear as the specification proceeds.

The invention is illustrated, in a preferred embodiment, by the accompanying drawings, in which—

Fig. 1 is a top plan view of a machine embodying my invention; Fig. 2, a side view in elevation; Fig. 3, a longitudinally sectional view, the section being taken as indicated at line 3 of Fig. 1; Fig. 4, a transverse sectional view, the section being taken as indicated at line 4 of Fig. 2; Fig. 5, a sectional detail view of the filter mechanism and its means of support within the casing; Fig. 6, a transverse sectional view of a slightly modified construction; Fig. 7, a diagram of the water flow; Fig. 8, a diagrammatic view of the wiring layout; Fig. 9, a schematic drawing of the mechanism for maintaining proper correlation between temperature and humidity; and Fig. 10, a broken top plan view of the regulating cams shown in Fig. 9.

In the illustration given in Figs. 1 to 5, inclusive, A designates a casing; B, a filter mounted in the casing; C, electrically driven fans for drawing air through the machine; D, a refrigeration machine; E, the water circulating system; and F, a water drainage system.

The casing A may be of any suitable construction. In the illustration given, I have shown the casing A mounted on rollers A′ and provided at its lower side with an opening through which air may enter the bottom of the casing. The filter B extends over the opening. In the upper part of the casing A are two circular openings in which are mounted louvers 10 by which the circulating air may be directed at a proper angle into the room.

The filter B may also be of any suitable construction adapted to remove foreign matter from the air entering the casing. With the construction shown in Fig. 5, the filter is supported on each side by ledges A^2 of casing A, and springs 11 center the filter with respect to the openings. When it is desired to remove the filter, the spring on one side may be compressed by moving the filter laterally until the other end of the filter drops through the opening. With the construction shown, the filter may be readily removed and replaced as desired.

The fan mechanism C may also be of any suitable construction. In the construction shown, a motor 12 is supported by suspension bracket 13. The shaft of the motor carries at each end a fan mounted within casing members 14, each having an inlet opening on its outer side. The fan casings 14 communicate through casings 14^a with the louvers 10.

The water-cooled refrigeration machine D may be of any suitable construction. In the illustration given, a standard type of ice refrigeration machine is shown. In view of the well known construction of this type of machine, a detailed description is believed to be unnecessary. The machine comprises a motor 15, a compressor 16, and a condenser 17. Pipes 18 containing the refrigerant extend into the space above the machine and encircle the fans 14.

The machine D is preferably mounted within a thermally and acoustically insulated box B′. Within the box, springs 19 may be employed to dampen the vibrations of the machine. The machine D may be equipped with an expansion valve 20, as is the usual practice.

The box B′ is provided on its outer side with a metal wall 21 which is extended above the top of box B′ to provide an open topped basin or reservoir 22. At the base of the reservoir is located a heater 23.

The water cooling system E is designed for the purpose of carrying away the heat from the compartment B′, for supplying water to the reservoir 22 when necessary, and also for aiding in the removal of drain water. The inlet water pipe connection 24 extends through casing A and is adapted to be connected to any suitable flexible hose unit (not shown). The hose is adapted to be connected to a faucet so that running water may be passed into the machine. Likewise, the outlet pipe connection 25, near the bottom of the machine, may be connected by suitable flexible hose to a drain. Brackets 26 are carried by casing A between the inlet and

outlet pipes 24 and 25 so that the hose connections, when not in use, may be coiled thereon.

Connected to the intake pipe 24 is a two-way valve 27 provided with a control-lever arm 28 to which is connected a control wire 29. The wire 29 runs to a control which will be later described. Beyond the valve 27 is an automatic valve 30 which controls the flow of water to the machine in accordance with the needs of the machine. From the valve 30, the intake water pipe is connected to a radiator 31 mounted in the upper part of box B'. The water circulates through the radiator 31 and then downwardly through pipe 31ª into the top of the compressor. From the compressor head, the water passes through line 31ª into cooler 17, and thence through outlet pipe 32 into the two-way valve 33. From the valve 33, the water passes through connection 34 into outlet pipe 25. A check valve 35 may be employed to prevent back flow of water through pipe 25.

Returning now to the two-way valve 27 on inlet pipe 24, a pipe 36 extends upwardly from valve 27 and is connected to a pipe 37 emptying into the basin 22 and also to a downwardly extending pipe 38. The pipe 38 extends through a float-controlled valve 39, and check valve 40. A by-pass pipe 41 connects pipe 38 with outlet pipe 25. Mounted in the by-pass 41 is an ejector 42. Directly above the two-way valve 33 is another check valve 43. The ejector 42 is connected by pipe 44 with a drain reservoir 45. A check valve 46 is located in line 44. A float valve 47 may be employed to control the flow of water from pipe 36 into the upper basin or reservoir 22.

The water draining system F may be of any suitable construction. In the illustration given, the drain tank 45 mounted below box B', is connected directly with the bottom of reservoir 22 by pipe 48. A control valve 49 is mounted in the upper part of pipe 48, and its control arm is connected by wire 50 with a control lever which will be later described. An overflow by-pass pipe 51 extends up into basin 22 and is connected with pipe 48 below valve 49.

The drain tank 45 is provided with a pair of floats 52 and 55 for controlling valves 33 and 39. Float 52 is connected by wire 53 with the control arm 54 of valve 33. Similarly, float 55 is connected by wire 56 with the control arm 57 of valve 39.

I also provide automatic control mechanism for regulating the refrigeration machine and the heater in order to properly condition the air. A thermostat 58 is supported on one side of the box B' and is connected to a depending temperature-responsive element 59. Preferably, the element 59 is shielded from the direct air current by baffle 60. Connected to the thermostat are electric wires which will be later explained in the description of the complete electric circuit. A high pressure cut-out 58ª is connected to the thermostat 58. A humidostat 61 is preferably supported within casing A and on the other side of box B'. It may be provided with a wet bulb 62 extending into the tube 63. Moisture may be supplied to the wet bulb by tank 64 which has a flow connection through pipe 65 with the drain reservoir 45. The humidostat is also connected in an electric circuit which will be later described in detail. A high pressure cut-out 61ª is connected to the humidostat.

Preferably, the casing A is provided on one side, as shown more clearly in Fig. 2, with an operating panel 66. On one side of the panel is mounted a main switch 67, and on the other side, a fan switch 68. A main control-lever 69 is also mounted in panel 66. The lever 69 controls the two-way valve 27 through wire connections, and also controls an electric switch which will be later described. The knob 70 may be rotated to control the coordinating cams which will be later described.

In the wiring diagram shown in Fig. 8, the current flows through main switch 67 and through line 71 to the fan motor 12, and back through line 72 to line 73. In the lines 73 and 67ª is a solenoid-controlled double switch 74. The solenoid 75 is mounted in a line 76 which is connected with humidostat 61 and high pressure cut-out 61ª. The humidostat 61 is then connected through line 77 with connecting line 78 in which is placed switch 68. The line 77 continues to contact point 78. The lines 73 and 67ª extend downwardly to connect with the switch member 79. The switch member 79 is controlled by the control-lever 69. When the switch is swung to the right, it closes the circuit in which the heater 23 is placed. When the switch is swung to the left, it closes the circuit in which compressor D is placed.

In the operation of the electrical mechanism illustrated in Fig. 8, when the switch 67 alone is closed, the fan motor 12 is set into operation. When the switch 68 is closed and switch 79 is swung to the right, the electric resistance heater 23 is brought within the closed circuit, while also the humidostat 61 and high pressure cut-out 61ª are brought into control. The heater is turned off and on by the humidostat 61 as the condition of the air requires it, the turning off of the heater being effected through the solenoid 75. When the switch 79 is swung to the left, the heater 23 is cut out and the circuit containing the compressor D is closed. Also, the circuit containing the thermostat 58 and the high pressure cut-out 58ª is closed. The switch 74 will therefore be kept closed until both the thermostat 58 and humidostat 61 are opened.

As shown more clearly in Fig. 9, I prefer to employ a single control knob 70 which may be manipulated from outside of panel 66 to change the setting simultaneously on both the thermostat and humidostat to meet the requirements of perfect comfort. The cams 80 and 81 are both mounted on the spindle of knob 70. The cam surfaces bear against rollers 82 and 83 carried, respectively, on spring-urged shafts 84 and 85. The shafts 85 are connected to control-levers 86 and 87 of the humidostat 61 and thermostat 58, respectively. The construction for changing the setting on these instruments is well known, and further detailed description is unnecessary. The cam surfaces of members 80 and 81 are so correlated as to give the proper humidity for any selected temperature. In other words, the cam surfaces bear the proper relation to each other as expressed by the well known "comfort line" on the psychrometric chart.

Eliminators or baffles 88 are preferably placed between the cooling coils 18 and the fan mechanism, in order to remove moisture from the air currents.

Operation

In the operation of the device, air passes through the aperture in the bottom of casing A, through filter B, along the outsides of the compartment B' and comes in contact with the refrigerating coils 18 near the top of the casing. Here the air is cooled below the dew point and

moisture from the air falls into the reservoir 22. The air passes through the fan openings in casing 14 and out through louvers 10.

The cooling water enters through pipe 24. Assuming that the control-lever 69 has been swung so as to set the compressor into operation and to permit water to flow into the radiator 31, the course of the water is as follows: The water passes through radiator 31, down through pipe 31^a into the compressor head, and thence through pipe 31^a into cooler 17. From the cooler 17, the water passes through pipe 32 and thence through valve 33, fitting connection 34, and into outlet pipe 25. The water which has condensed about the cooling coils 18, and which has dropped into the reservoir 22, may pass through pipe 48 into the drain tank 45. When the water in the drain pipe 45 rises beyond a certain level, the float 52, through connection 53, actuates arm 54 and operates valve 33 so as to direct the water in pipe 32 upwardly through valve 43, and then downwardly through ejector 42. The current of water passing through ejector 42 draws water from reservoir 45, through check valve 46, into the ejector, and the water is discharged together with the cooling water through outlet pipe 25.

When the control 69 is swung in the other direction so as to cut off the compressor and to turn on the heater, the valve 27 stops the flow of water through radiator 31 and directs it upwardly through pipe 38. At the same time, the control 69 through its connections, closes valve 49. The water now passes through pipe 36 and float-controlled valve 47 into the reservoir 22. If the water rises above the desired level, and the float 47 fails to control the intake of water, the excess water may flow off through bypass 51 and pipe 48 into the drain tank 45. If the water in the drain tank 45 rises beyond a predetermined level, the float 55 actuates by its connection 56 the control arm 57 of valve 39, and permits water to pass downwardly through pipe 38 and thence through ejector 42. The ejector draws off water from the drain tank 45 and discharges it through pipe 25. The flow of water is diagrammatically set forth in Fig. 7.

In the first position of the control valve 69, as described above, the air is conditioned for summer use; that is, the air is cooled and discharged with the proper humidity. In the second operation described, in which the control lever 59 was swung to direct the water away from the radiator 31 and into reservoir 62, the air is conditioned for winter use, the heater in the reservoir 22 driving off vapor in accordance with the requirements of the humidostat 61.

The operation of the electrical circuit has already been described in detail. Assuming that the switches 67 and 68 are closed, the swinging of switches 79 to the right, as illustrated in Fig. 8, by means of control lever 69, causes the heater 23 to be set into operation, and the humidostat 61 controls the heater through solenoid 75. When the switch 79 is swung to the left by means of control-lever 69, the heater is cut out of operation and the compressor D is started. At the same time, the thermostat 58 and humidostat 61 are brought within the closed circuit. When it is desired to change the temperature of the air which is emitted through louvers 10, the control knob 70 may be manipulated. The cam members 80 and 81 engage rollers 82 and 83, and by means of connections 84, 85, 86 and 87, vary the setting of the instruments 61 and 58.

In the modification illustrated in Fig. 6, the main mechanism is substantially the same. However, the casing A is supported upon stationary supports A^3 and the fan and motor therefor are supported in a detachable casing A^4. Below the fan mechanism, I prefer to employ an inner casing wall A^5 which converges to form a funnel portion A^6. Within the funnel are arranged the cooling coils 18', and below the funnel, is a reduced pan or drip receptacle 22^a. This construction enables the apparatus to be shipped in sections and to be readily assembled by the user.

While the control mechanism has been described in connection with the specific humidity and temperature control mechanisms disclosed, it will be understood that the control may be employed in connection with other kinds of air conditioning systems, and that the adaptation to such new system or systems can be readily made by a mechanic without departing from the spirit of my invention.

The mechanism is simple, compact, and requires no skill in installation or operation. The unit is fabricated in its entirety at the factory, and for operation within a room, the only connections required are the hose connections with the faucet and drain and an electrical connection.

While in the foregoing description, I have set forth certain specific instruments and mechanisms, it will be obvious that many changes or substitutions may be made without departing from the principles of my invention. The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, but the appended claims should be construed as broadly as permissible, in view of the prior art.

I claim:

1. In air conditioning apparatus of the character set forth, a casing provided at its bottom with an inlet opening, a removable filter over said opening, an insulation casing supported above said filter, a reservoir supported by said insulation casing, refrigerating apparatus within said insulation casing, cooling coils connected with said apparatus and supported above said reservoir, said casing being provided at its top with an outlet opening above said cooling coils, means for passing air through said casing and out of said discharge opening, means for conducting a cooling fluid to the refrigerating apparatus, and means for discharging together the water collecting in said reservoir and said cooling water.

2. In air conditioning apparatus of the character set forth, a casing provided with an inlet at its bottom and an outlet at its top, a removable filter over said inlet opening, an insulation box supported above said filter, a reservoir supported by the top of said box, refrigerating apparatus within said insulation box and having cooling coils extending above said reservoir, an electric resistance heating element adjacent said reservoir and adapted to heat water therein, means for supplying cooling water to said refrigerating apparatus and water to said reservoir, and switch means for operating said refrigerating apparatus or said heating element.

3. In air conditioning apparatus of the character set forth, a casing provided with an inlet at its bottom and an outlet at its top, a removable filter over said inlet opening, an insulation box supported above said filter, a reservoir supported

by the top of said box, refrigerating apparatus within said insulation box and having cooling coils extending above said reservoir, an electric resistance heating element adjacent said reservoir and adapted to heat water therein, means for supplying cooling water to said refrigerating apparatus and water to said reservoir, switch means for operating said refrigerating apparatus or said heating element, and automatic control means for varying the operation of said refrigerating apparatus or said heater in accordance with predetermined temperatures and humidity.

4. In air conditioning apparatus of the character set forth, a casing having inlet and outlet openings, an insulation box supported within said casing, a drain tank below said box, a reservoir supported by the top of said box, pipe connections between said reservoir and said drain tank, refrigerating apparatus within said box and having cooling coils supported above said reservoir, means for supplying cooling water to said apparatus, and float-control means associated with said drain tank for automatically discharging water from said tank together with the cooling water.

5. In apparatus of the character set forth, a casing having an inlet opening at its bottom and an outlet opening at its top, an insulation box supported within said casing, refrigerating apparatus within said box, cooling coils from said refrigerating apparatus extending above said box, fan means within said cooling coils, eliminators between said fan means and said coils, a reservoir supported by said box below said coils, means for supplying a cooling fluid to said refrigerating apparatus, means for conducting away said cooling water and condensate in said reservoir, and automatic temperature and humidity-responsive means in said casing for controlling the operation of said refrigerating apparatus.

6. In apparatus of the character set forth, a casing having an inlet opening at its bottom and an outlet opening at its top, an insulation box supported within said casing, refrigerating apparatus within said box, cooling coils from said refrigerating apparatus extending above said box, fan means within said cooling coils, eliminators between said fan means and said coils, a reservoir supported by said box below said coils, means for supplying a cooling fluid to said refrigerating apparatus, means for conducting away said cooling water and condensate in said reservoir, automatic temperature and humidity-responsive means in said casing for controlling the operation of said refrigerating apparatus, and a single control member for simultaneously adjusting said humidity and temperature-responsive devices in a predetermined relation.

7. In air conditioning apparatus of the character set forth a casing provided with inlet and outlet openings, an insulation box supported within said casing and providing between it and said casing an air passage, refrigerating apparatus within said insulation box, cooling coils connected with said apparatus and supported within said air passage, a reservoir supported in said casing and adapted to receive condensate collecting on said coils, a humidity-responsive device supported within said air passage and provided with a wet bulb equipped with a water cup, and a conduit adapted to lead water from said reservoir to said cup.

8. A movable air conditioning unit comprising a casing having an open bottom wall and outlet apertures in its top wall, a removable filter supported over the opening in the bottom wall, an insulation box supported above said filter, fan means mounted in the upper part of the casing, said insulation providing between its sides and the sides of said casing an air passage, refrigerating apparatus within said insulation box and having cooling coils extending in the space adjacent said fan means, a drip pan below said cooling coils, means for supplying a cooling fluid to said refrigerating apparatus, inlet and outlet connections for said cooling fluid, said connections being adapted to receive flexible hose connections, and means for discharging the water from the reservoir with the cooling fluid.

9. In air conditioning apparatus of the character set forth, a casing provided with an inlet at its bottom and an outlet at its top, an insulated box supported within said casing, a reservoir supported by the top of said box, refrigerating apparatus within said insulated box and having cooling coils extending above said reservoir, means for passing air through said casing and out of said discharge opening, means for supplying a cooling fluid to the refrigerating apparatus, and means for discharging together the water collecting in said reservoir and said cooling water.

10. An air conditioning unit comprising a casing equipped at its bottom with an inlet and at its top with an outlet, an insulation box supported within said casing, a reservoir carried by said insulation box, refrigerating apparatus within said insulation box and equipped with cooling coils extending above said reservoir, a removable filter supported over the inlet opening and below said insulation box, means for supplying cooling water to the refrigerating apparatus, and automatic means for conducting away the cooling water and water from the reservoir.

11. In air conditioning apparatus of the character set forth, a casing provided with an inlet and an outlet, an insulation box supported within said casing, a reservoir supported by said box, refrigerating apparatus within said insulation box and having cooling coils extending above said reservoir, an electric resistance heating element adjacent said reservoir and adapted to heat water therein, means for supplying cooling water to said refrigerating apparatus and water to said reservoir, and switch means for operating said refrigerating apparatus or said heating element.

12. In air conditioning apparatus of the character set forth, a casing having inlet and outlet openings, an insulation box supported within said casing, refrigerating apparatus within said box and having cooling coils supported outside of the box and within said casing, a reservoir supported below said cooling coils, a drain tank supported in said casing, and means for conducting the water from said reservoir to said drain tank, means for supplying cooling water to said apparatus, and float-control means associated with said drain tank for automatically discharging water from said tank together with the cooling water.

13. In apparatus of the character set forth, a casing having an inlet opening at its bottom and an outlet opening at its top, an insulation box supported within said casing, refrigerating apparatus within said box, cooling coils from said refrigerating apparatus extending above said box, fan means within said cooling coils, a reservoir supported by said box below said coils, means for supplying a cooling fluid to said refrigerating

apparatus, means for conducting away said cooling water and condensate in said reservoir, and automatic temperature and humidity responsive means in said casing for controlling the operation of said refrigerating apparatus.

14. In apparatus of the character set forth, a casing having an inlet opening and an outlet opening, refrigerating apparatus supported within said casing, a condensate reservoir, cooling coils from said refrigerating apparatus extending above said reservoir, means for passing air into contact with said cooling coils, means for supplying a cooling fluid to said refrigerating apparatus, means for conducting away said cooling water and condensate in said reservoir, automatic temperature and humidity-responsive means in said casing for controlling the operation of said refrigerating apparatus, and a control-member for simultaneously adjusting said humidity and temperature-responsive devices in a predetermined relation.

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