

Feb. 10, 1953

D. S. RENSE

2,628,083

AIR-CONDITIONING APPARATUS

Filed July 29, 1946

2 SHEETS—SHEET 1

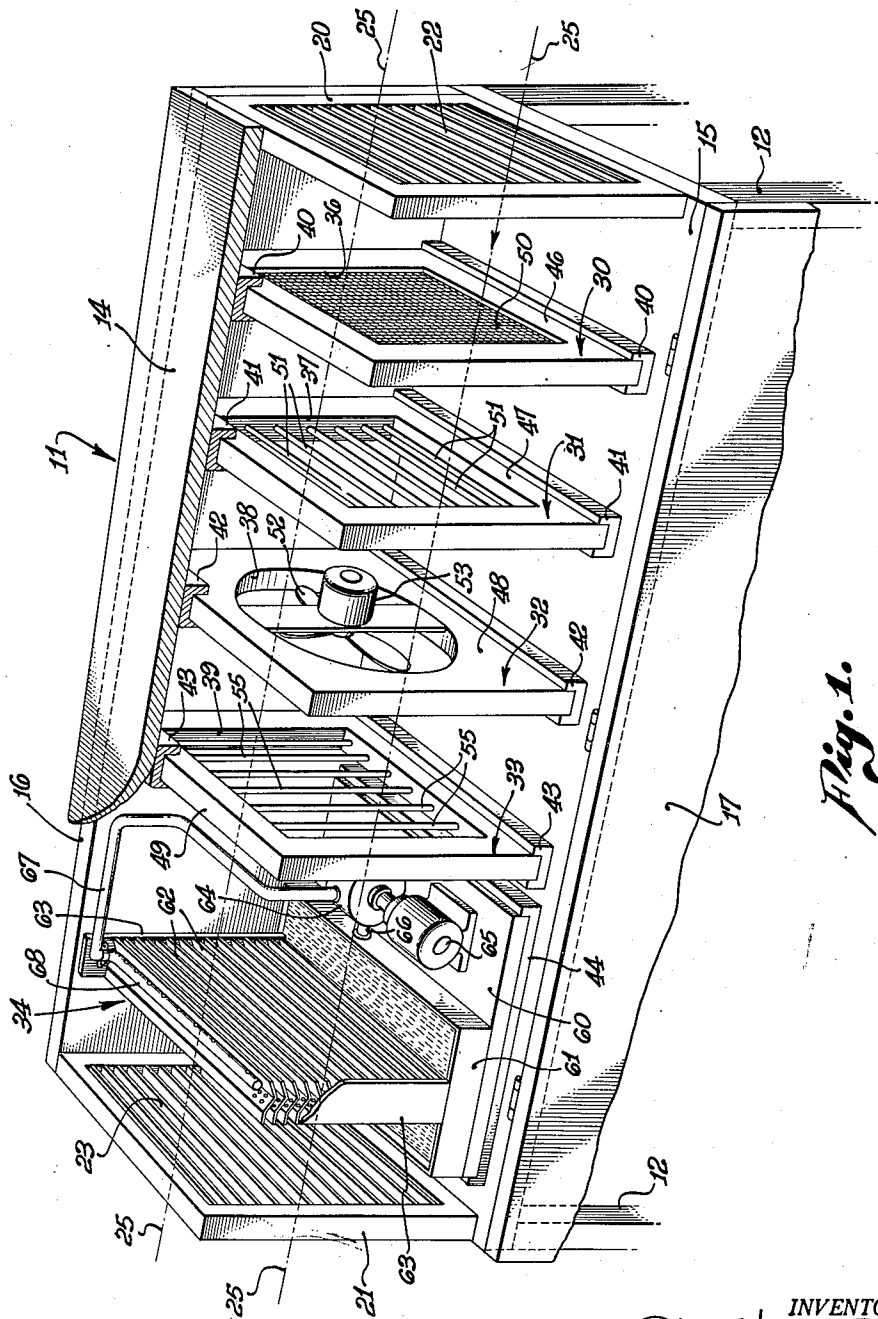


Fig. 1.

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2 SHEETS—SHEET 2

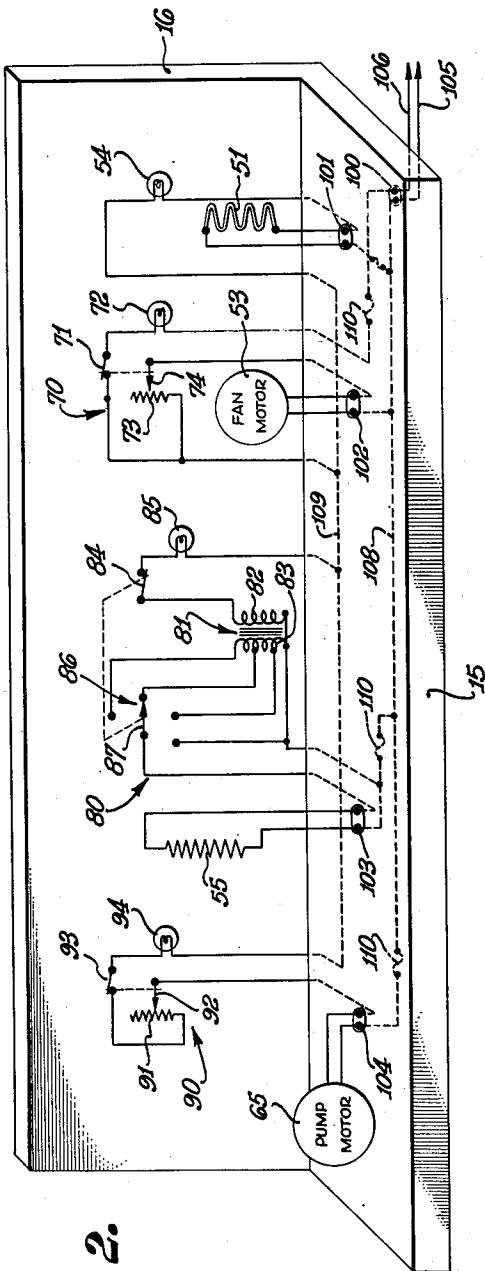


Fig. 2.

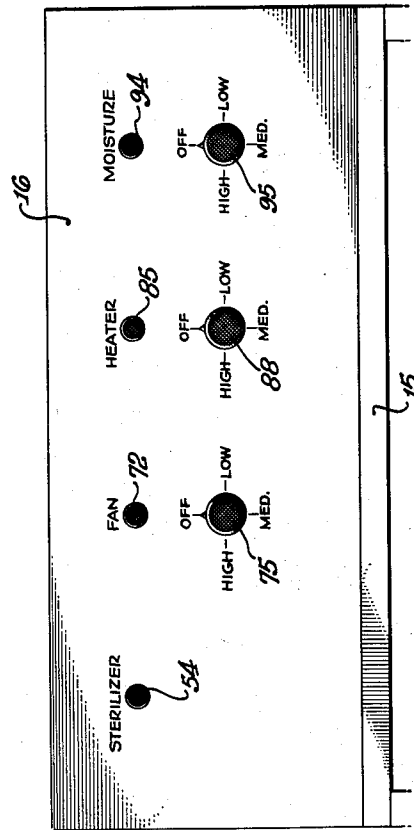


Fig. 3.

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AIR-CONDITIONING APPARATUS

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4 Claims. (Cl. 261-14)

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My invention relates to air conditioning apparatus and more particularly to an improved apparatus for treating the air in the room of a dwelling house, office building, or the like.

An object of my invention is to provide a portable, flexible, and compact air conditioning apparatus which may be utilized for different purposes according to the needs of the user.

Another object of my invention is to provide air conditioning apparatus which includes a plurality of air treating units aligned in a housing to offer minimum resistance to air being circulated therethrough.

Another object of my invention is to provide conditioning apparatus which utilizes a plurality of readily movable air treating units which serve to treat air in different ways.

Another object of my invention is to provide an improved housing or air conditioning apparatus in which different removable units which perform different air treating purposes are readily installed.

Another object of my invention is to provide air conditioning apparatus having a circulating fan with an evaporator and a heater which are independently controllable so as to permit regulation of both the temperature and the humidity of air treated.

Another object of my invention is to provide air conditioning apparatus with air purifying units and other air treating units so as to purify and treat the air simultaneously.

Another object of the invention is to provide air conditioning apparatus having a circulating fan, an electric sterilizer, an electric heater, and an electrically controlled evaporator with a control circuit which permits energization of such units only when the fan is operated.

In order to accomplish the foregoing and other objects of my invention, I provide a portable cabinet which includes a housing which has openings in opposite ends thereof. Within the housing I position an air circulating unit including a fan for circulating air therethrough along a path extending from one end of the housing to the other and position various air treating units of the type desired in this path. Preferably the units are disposed transversely of this path and have air flow passages along the path to minimize air resistance. In a preferred embodiment of my invention, the housing is designed to receive and support a plurality of any number of air treating units desired transversely of the air conduction path thus facilitating removal and substitution of air treating units as desired to suit the particular requirements of the user.

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Air treating units which I utilize in the preferred embodiment of my invention include an air purifying unit, an air heating unit, an evaporator unit in addition to a fan. These different units may be selectively installed within the housing in different combinations in order to accomplish different purposes. For example, when in addition to the fan an air purifying apparatus comprising, say, an air sterilizing unit including an ultraviolet lamp and an air filter unit is installed, air circulating through the housing is both cleaned and sterilized. By also installing an air heating unit the air of the room in which the unit is used is warmed as well as cleaned and sterilized. Alternatively, by also installing an evaporator unit without the air heating unit, the air in the room may be cooled and humidified as well as cleaned and sterilized. And by installing both the air heating unit and the evaporator unit, both the temperature and the humidity of the room air may be controlled at the same time that the air is being cleaned and sterilized.

The fan, the ultra-violet ray lamp, the heating unit, and the evaporator unit are preferably controlled electrically. In order to protect the various units from excessive heating, interlocked control circuits are provided to prevent energization of the evaporator unit and the air heating unit, and the ultra-violet ray lamp unless the fan is energized to circulate air through the housing.

My invention, together with the foregoing and other objects thereof will be more readily understood from a consideration of the detailed description of the particular embodiment thereof which is illustrated in the drawing and described hereinbelow. Although only one arrangement of air conditioning apparatus, and only one specific circuit for controlling that apparatus, is illustrated in the accompanying drawing, it is to be understood that my invention is not limited to the details thereof but that reference is to be made to the appended claims to determine the scope of my invention.

In the drawings wherein like reference characters indicate like elements throughout the several figures:

Figure 1 is a perspective view of my improved air conditioning apparatus with a portion of the housing walls removed;

Fig. 2 is an isometric wiring diagram of the electric circuits used for controlling the various units of this air conditioning apparatus; and

Fig. 3 is an elevational view of the control panel of the air conditioning apparatus.

Referring to the drawings, there is illustrated

a self-contained air conditioning apparatus incorporating features of the present invention and comprising a cabinet including a housing 11 mounted upon legs 12—12. The housing possesses longitudinal top and bottom walls 14 and 15 respectively, and longitudinal front and rear walls 16 and 17 respectively, and end walls 20 and 21 respectively. These walls may be composed of wood or metal. All of the walls are of rectangular shape thus forming a box shaped housing. The end walls 20 and 21 include lattices or grills 22 and 23 respectively having suitable openings therein so as to permit circulation of air through the housing from one end to the other along substantially straight paths indicated by dashed lines 25, 25.

An air filter unit 30, an air sterilizing unit 31, an air circulating unit 32, an air heating unit 33, and an evaporator unit 34 are suitably supported within the housing 11. All five of these units are arranged transversely of the air circulation paths 25, 25 in the order named between the end walls 20 and 21. Each of the units has openings for air passages therein which are collinear with the openings in the end walls 20 and 21.

All of the air treating units are constructed in readily removable form in order to facilitate their replacement and repair and in order to facilitate removal of any unit which is not required for the purpose at hand. The rear wall 17 is hinged at the lower edge thereof to the bottom wall 15 in order to provide a door at the rear side of the housing through which any of the air treating units may be inserted and removed.

Four pairs of guide ways 40—40, 41—41, 42—42, and 43—43 are arranged transversely in the housing with the two members of each pair rigidly secured to the interior surfaces of the top and bottom walls 14 and 15 respectively with one member of each pair directly above the other. These guide ways serve to support the filter unit, the sterilizing unit, the air circulating unit, and the heating unit respectively in fixed position within the housing 11. The guide ways are in the form of U-shaped crossbars of the same size and shape, so that air treating units of the same external size and shape may be arranged interchangeable within the housing. Also a single guide way 44 is secured to the bottom wall in order to receive and support the evaporator unit 34 within the housing.

Additional guide ways may be provided, if desired, in order to permit use of additional air treating units. With an additional pair of such guide ways for example, another filter unit, or another sterilizing unit, or another heating unit may be included in the housing.

Considering now the individual air treating units in more detail, the filter unit 30, the sterilizing unit 31, the air circulating unit 32, and the heating unit 33 include rectangular frame structures 46, 47, 48, and 49 respectively. These frame structures are all of the same external shapes and dimensions in order to facilitate their interchange and arrangement within the housing.

The frame structure 46 of the filter unit has a large rectangular opening 36 therein. A body 50 of filter material such as glass wool is suitably supported in this opening. This frame structure 46 fits slidably in the grooves of the first pair of guide ways 40, 40 thus supporting the filter unit in a vertical plane transverse to the length of the housing. The filter 50 lies transversely of the air circulation paths 25, 25 and serves to remove dust or other obnoxious particles therefrom.

The frame structure 47 of the sterilizer unit has a large rectangular opening 37 therein. A plurality of mutually spaced ultra-violet ray lamps 51 of tubular construction are supported horizontally one above the other in this opening. This frame structure fits slidably in the grooves of the second pair of guide ways 41, 41 thus supporting the sterilizer unit in a vertical plane, transversely of the length of the housing. The ultra-violet ray lamps 51 lie transversely of the air circulating path 25, 25 and serve to sterilize the air being circulated through the housing.

The frame structure 48 of the air circulating unit 32 has a large circular opening 38 therein. A fan 52 driven by an electric motor 53 is centrally mounted in this opening. This frame structure 48 fits slidably in the grooves of the third pair of guide ways 42—42 thus supporting the air circulating unit in a vertical plane transversely of the length of the housing. Air which has been purified by the combined action of the filter 50 and the sterilizer and the ultra-violet ray lamps 51 is forced through the housing by means of the fan 52.

The rectangular frame 49 of the air heating unit 33 has a large rectangular opening 39 therein. A plurality of mutually spaced electric heaters 55 of either the open coil or Calrod type are supported vertically in spaced side by side relation in this opening. The frame 49 fits slidably in the grooves of the fourth pair of guide ways 43, 43 thus supporting the heating unit in a vertical plane transversely of the length of the housing. The heaters 55 lie in the path 25 of the air circulating through the housing and serves to heat the air to any desired degree, the amount of heating depending upon the rate of flow of the air through the housing and upon the electric power supplied through the heaters.

The humidifying and cooling unit 34 includes a base plate 60 upon which a tray or drip pan 61 is rigidly supported. The plate 60 fits slidably in the groove of the guide way 44. The drip pan 61 extends lengthwise across the width of the housing. This unit includes a plurality of perforated troughs 62 arranged in a vertical array directly above the drip pan 61. These troughs lie transversely in the housing and are supported and closed at their ends by upright members 63, 63 which extend upward at the ends of the pan 61. With this arrangement the horizontal spaces between successive troughs lie transversely of the housing across the air circulating paths 25, 25. A circulating pump 64 and an electric motor 65, which serves to drive it, are also mounted upon the base plate 60. The circulating pump 64 is provided with inlet pipe 66 connected to one side of the pan 61 and an outlet pipe 67 which connects with a perforated discharge pipe 68 which is suitably supported directly above the trough 62.

The circulating pump 64 serves to draw water from the drip pan 61 and to discharge it through the perforated pipe 68 into the array of perforated troughs through which the water drips by gravity into the pan 61. The pump 64 is preferably of the positive displacement type to permit operation at low pumping rates and the motor 62 is preferably of the variable speed type, in order to enable the quantity of water dripping through the array of troughs to be suitably regulated. By virtue of the combined operation of the circulating pump 64 and the array of troughs 62, a thin veil of water is formed directly across the air circulating paths 25, 25. Air passing through this veil of water causes some of the water to evapo-

rate thus cooling the air and increasing its humidity.

It is to be noted that all the units fit closely within the housing so as to minimize air leakage around the frames, and that each of the units is provided with air flow passages which extend longitudinally of the housing thereby minimizing air resistance as well as providing a convenient, flexible arrangement.

While the air treating units may be arranged in other sequences within the housing, the arrangement hereinabove described is the optimum. In this arrangement the filter unit at the inlet serves to keep the other units clean. The installation of the sterilizer on the upstream side of the fan and the heater on the downstream side of the fan minimizes the heating of these units. By installing the evaporator after the other units, advantage may be taken of the prior heating of the air if desired to maximize the addition of moisture to the air. The installation of the evaporator at this point also precludes condensation of an excessive amount of moisture on the other units and on the electric control circuits.

By suitably energizing the ultra-violet ray lamps 51, the fan motor 53, the heaters 55 and the pump motor 65, air circulating through the housing 11 may be heated and cooled and humidified in widely different degrees as well as sterilized. The electric circuit used for controlling the operation of the air treating units includes a fan control circuit 70, a heater control circuit 80, and a pump motor control circuit 90 as illustrated in Fig. 2. These circuits are controlled by knobs 95, 88, and 75 and their operation indicated by indicator lights 54, 72, 85, and 94 as illustrated in Fig. 3.

In order to facilitate making connections to the control circuit, five electric plug-type connecting means 100, 101, 102, 103, and 104 of conventional type are arranged in the bottom wall 15 of the housing. The first connecting means 100 is used for connecting the circuit to the domestic power mains through two external conductors 105 and 106. The remaining four connecting means 101, 102, 103, and 104 are used respectively for connection of the ultra-violet lamps 51, the fan motor 53, the heaters 55, and the pump motor 65 into the circuit. One contact of each of these plugs is connected to a bus wire 108 which in turn is connected to one of the external conductors 105 through the plug 100. A second bus wire 109 is connected through a first single pole switch 71 and a fan operation indicator lamp 72 in the fan control circuit 70 to the other external conductor 106 through the plug 100. The fan motor 53 is connected between the two bus wires 108 and 109 through a variable resistor 73 and a movable contact arm 74. The movable arm 74 and the switch 71 are so ganged that when the arm 74 is set in a neutral position to include a maximum electrical resistance in the fan motor circuit, the switch 71 is open, and when the movable arm 74 is moved from this neutral position to any active position in which the amount of resistance in series with the fan motor is reduced, the switch 71 is closed, thus connecting the two bus wires 108 and 109 across the power main through the conductors 105 and 106 and operating the fan motor.

The ultra-violet ray lamps 51 are connected through a sterilizer operation indicator light 54 across the two bus wires 108 and 109, so that the sterilizer lamps 51 are energized whenever the motor 53 is operating. The heater control circuit

80 and the pump motor control circuit 90 are likewise connected directly across bus wires 108 and 109, and they are prepared for operation only when the switch 71 is closed to operate the fan motor 53.

The heater control circuit 80 includes a transformer 81 having a primary winding 82 and a secondary winding 83. The primary winding 82 is connected through a second single pole switch 84 and a heater operation indicator lamp 85 across the bus wire 108 and 109. The heaters 55 may be selectively connected across a desired fraction of the secondary winding 83 through a multiple contact rotary switch 86 having a movable arm 87 which is ganged with the arm of the single pole switch 84. The switch 84 and the rotary switch 86 are so ganged that when the movable arm 87 is in the zero voltage position in which the secondary winding is cut out, the switch 84 is open. And while the rotary arm 87 is in any active position in which the heaters 55 are connected across a portion of the secondary winding, the switch 84 is closed. The transformer 81 thus supplies a voltage across the resistor 55 at a value depending upon the quantity of heat to be supplied by the heaters.

The motor pump 65 is connected across the two bus wires 108 and 109 through a variable resistor 91 having a movable arm 92 and through a third single pole switch 93 and a heater operation indicator lamp 94. The movable arm 92 and the single pole switch 93 are so ganged that the voltage applied across the pump motor 65 may be varied at will or shut off completely.

Suitable fuses 110 are included in various lines to protect the various units.

The three knob controls 75, 88 and 95 are arranged in a horizontal line on the front wall 16 of the housing as illustrated in Fig. 3. The operation of the arm 74 and the switch 71 in the fan motor circuit are controlled by means of a knob 75; the rotary switch 87 and the single pole switch 84 are controlled by a knob 88; and the movable arm 92 and the single throw switch 93 are controlled by a knob 95.

The moisture indicator lamp 94, the heater operation indicator lamp 85, and the fan operation lamp 72 are mounted in a horizontal line directly above the control knobs 75, 88, and 95 respectively. The sterilizer operation indicator lamp 52 is mounted in an offset position on that line.

By means of the control circuit described, the ultra-violet ray lamp 51, the heaters 55, and the pump motor 65 may be operated only if the fan motor 53 is energized, thus protecting these various elements from injury due to overheating since they are energized only when air is circulating through the housing. Also by means of the control circuit described the relative energization of the fan motor 53, the heaters 55, and the pump motor 65 may be varied in any manner desired. By virtue of the fact that the energization of these three elements may be varied, temperature, and moisture contents of the air being circulated through the housing may be changed according to circumstances. As previously explained either the evaporator unit 34 or the heating unit 33 may be energized if desired without energizing the other. Thus, for example the heating unit 33 may be energized to heat a room to any desired degree in winter. Also the evaporator unit 34 alone may be energized to cool a room to any desired degree in summer particularly in a dry climate. Also both the heater unit

33 and the evaporator unit 34 may be energized if it is desired to increase the moisture content of air in a room and at the same time to maintain its temperature at a higher value than would be attained if the evaporator unit 34 operated alone. This type of operation is particularly desired for some hygienic purposes. In any event whether the evaporator unit or the heating unit or both are operated the air being circulated through the apparatus is sterilized.

From the foregoing description of my invention it will be apparent that I have provided a flexible and compact air conditioning apparatus which may be used for any one of the many different purposes according to the needs or desires of the user. While only a single embodiment of my invention has been illustrated and described in detail, many changes and modifications may be made in the form, material or relative arrangement of the parts without departing from the scope of the invention as set forth in the appended claims.

I claim:

1. An air conditioning apparatus comprising a housing, a fan in said housing for circulating air through said housing along a predetermined path therein, an air sterilizer unit comprising a gaseous discharge lamp disposed in said housing in sterilizing relationship with air circulating along said path, a movable element having a neutral position and a plurality of active positions for controlling the speed of said fan, means controlled by movement of said element from said neutral position to one of said active positions for energizing said fan, the fan speed depending upon the active position in which said element is set, and means controlled by movement of said element from said neutral position to an active position for energizing said gaseous discharge lamp.

2. An air conditioning apparatus comprising a housing, a fan in said housing for circulating air through said housing along a predetermined path therein, an air sterilizer unit comprising a gaseous discharge lamp disposed in said housing in sterilizing relationship with air circulating along said path, an air heater unit comprising an electric heater disposed in said housing in heating relationship with air circulating along said path, a first electric circuit associated with said heater, a switch having an open position and a closed position, a second circuit controlled by closure of said switch for energizing said fan and said gaseous discharge lamp, and circuit means controlled by closure of said switch for preparing said first electric circuit for operation, and means operative in said first electric circuit only when so prepared for energizing said heater.

3. An air condition apparatus comprising a housing, a fan for circulating air along a predetermined path through said housing, an air sterilizer unit comprising a gaseous discharge lamp disposed in sterilizing relationship with air circulating along said path, an evaporator unit comprising an electric driven pump and also comprising evaporator elements disposed across said path, an electric circuit associated with

said pump, a movable element having a neutral position and an active position, means controlled by movement of said element from said neutral position to said active position for energizing said fan, and said gaseous discharge lamp and for preparing said electric circuit for operation, and means operative in said electric circuit only when so prepared for controlling the pumping rate of said pump.

4. An air conditioning apparatus comprising a housing, a fan for circulating air along a predetermined path through said housing, an air sterilizer unit comprising a gaseous discharge lamp disposed in sterilizing relationship with air circulating along said path, an air heater unit comprising an electric heater disposed in heating relationship to air circulating along said path, a first electric circuit including means for controlling the supply of electric energy to said heater, an evaporator unit comprising an electric driven pump and also comprising evaporator elements disposed across said path, a second electric circuit including means for controlling the speed of said pump, a movable element having a neutral position and a plurality of active positions for controlling the speed of said fan, means controlled by movement of said element from said neutral position to one of said active positions for energizing said fan, the fan speed depending upon the active position in which said element is set, means controlled by movement of said element from said neutral position to an active position for energizing said gaseous discharge lamp, and means controlled by movement of said element from said neutral position to an active position for preparing said two electric circuits for operation and controlled by movement of said element from an active position to said neutral position for rendering said two electric circuits inoperative.

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