May 29, 1956 R. S. LOWENSOHN 2,747,377

AIR CONDITIONING UNIT

Filed May 2, 1955 2 Sheets-Sheet 1

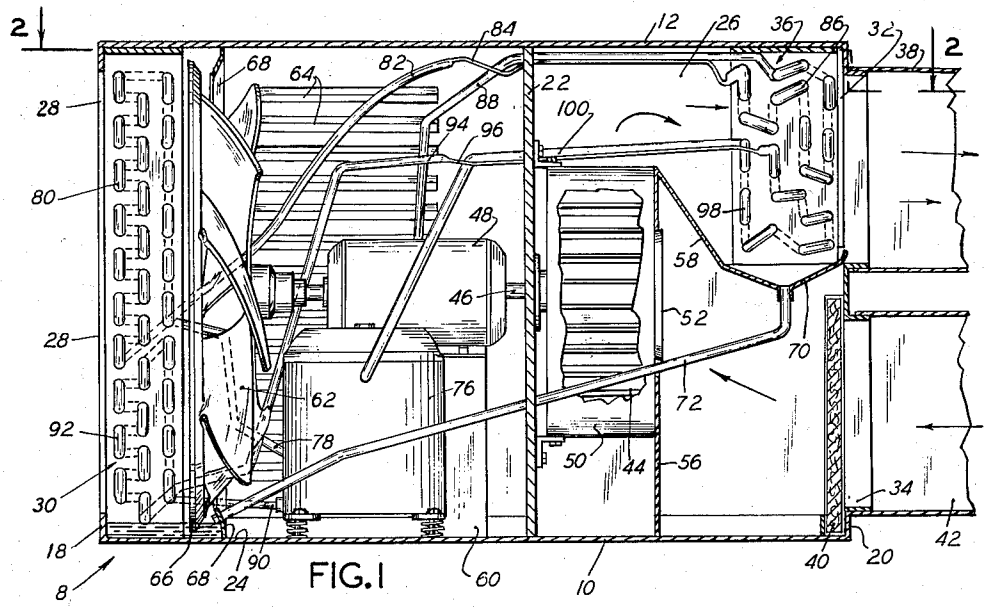



FIG. 1

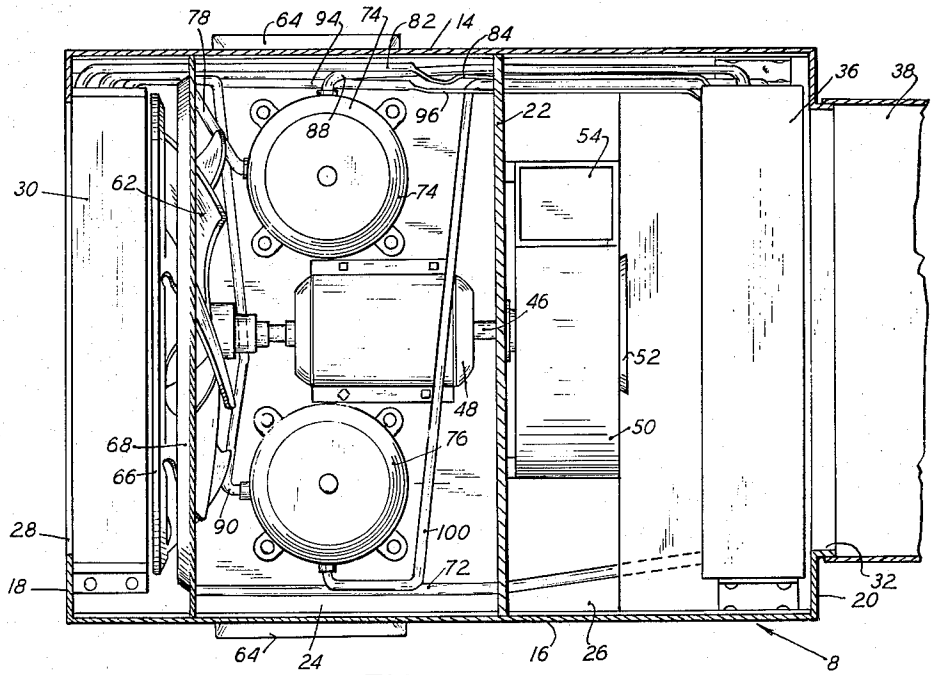



FIG. 2

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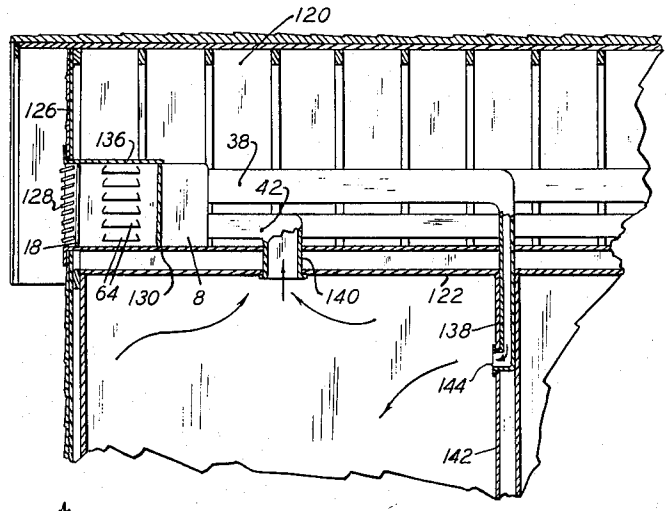



FIG. 3

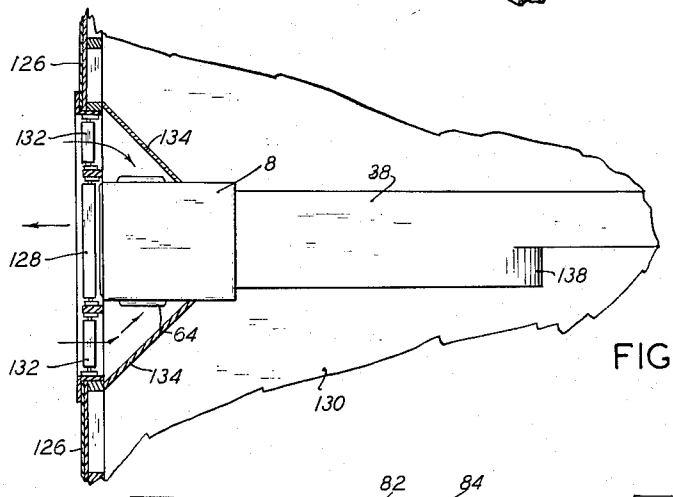



FIG. 4

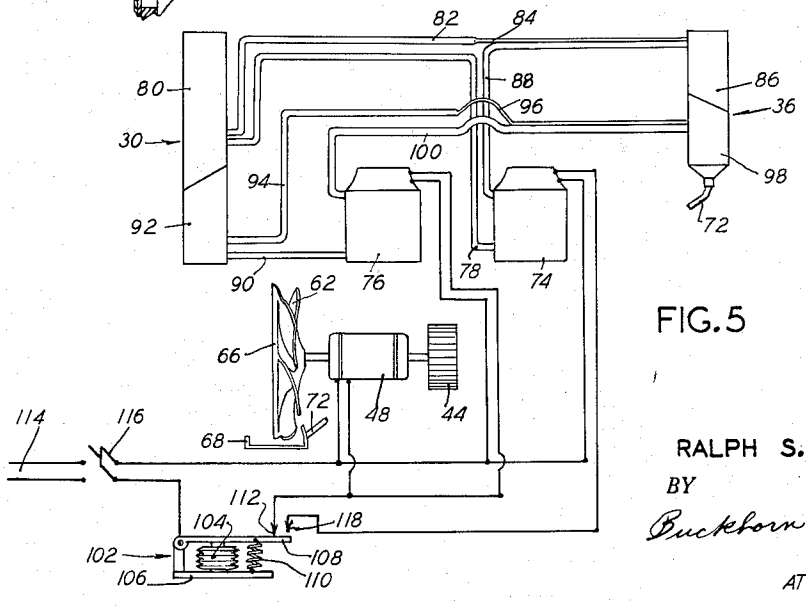



FIG. 5

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United States Patent Office 2,747,377 Patented May 29, 1956



2,747,377

# AIR CONDITIONING UNIT

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Application May 2, 1955, Serial No. 505,361

6 Claims. (Cl. 62—4)

This invention relates to an air conditioning unit, and more particularly to a unit having a cooling system of the air cooled condenser type, which unit is especially adapted for installation in the attic of a dwelling or other building for connection with ducts in order to circulate cooled air through the rooms of such building.

The air conditioning unit of the present invention is a unitary structure merely requiring for operation a supply of outside air for cooling the condenser and connection to a suitable source of electric power. It contains two separate cooling systems, each including a motor-compressor unit of the hermetically sealed type with a condenser and an evaporator connected in series with the compressor, one of the cooling system operating under low load conditions and both cooling systems operating under high load conditions. The evaporators of the two systems are adjacent sections of an evaporator structure and a fan, preferably of the centrifugal type, is employed to pass air to be cooled through both evaporators. Such fan also serves to force the cooled air through suitable ducts into the rooms to be cooled and to withdraw such air from the rooms after it is warmed. The condensers of the two systems are also adjacent sections of a condenser structure and are arranged in superimposed position. A fan of the radial blade type is employed to draw cooling air from the outside of the dwelling and direct it through both of such condensers. The latter-mentioned fan is provided with a slinger ring and the water which condenses on the cooling elements of the evaporator structure is collected and delivered into a tray or reservoir below the condensers. The fan is positioned with its slinger ring dipping into such tray so that the cool water from the evaporator is thrown upwardly upon the condensers and evaporated thereon. With the arrangement just described, it has been found possible to make the lower condenser section much smaller than the upper, for example, approximately one half the size of the upper condenser section so that the lower condenser section includes approximately one third of the total condenser area or volume. Despite the difference in size, substantially the same condensing effect is obtained in both condenser sections because of the better contact between the lower condenser section and the cooled water from the evaporator. This results in a reduction of the total amount of condenser surface considered necessary in the prior art for two cooling systems. The two condenser sections preferably form part of a single unitary structure occupying substantially the entire area of one end of the air conditioning unit, the casing of such air conditioning unit having provision for entrance of condenser cooling air through the sides thereof. Also, the two evaporator sections preferably form part of a single unitary structure extending across and occupying approximately one half of the vertical height of the unit of the other end of the air conditioning unit so as to provide room for a return duct connected to the lower portion of such end of the unit. The result is a compact, efficient air conditioning unit which is easily installed.



It is therefore an object of the invention to provide an improved air conditioning unit particularaly suitable for installation in the attic of a dwelling.

Another object of the invention is to provide an air conditioning unit having two separate cooling systems of the compressor-condenser-evaporator type which involves an improved arrangement of the elements thereof, including the condensers and evaporators.

A further object of the invention is to provide an air conditioning unit in which an improved condenser structure provides more efficient use of the condensing are in an arrangement involving two separate cooling systems, each including a compressor, a condenser and an evaporator.

Other objects and advantages of the invention will appear in the following description given in connection with the attached drawing of which;

Fig. 1 is a vertical section taken longitudinally through an air conditioning unit in accordance with the present invention;

Fig. 2 is a horizontal section taken on the line 2—2 of Fig 1;

Fig. 3 is a vertical, sectional view taken through a portion of a building showing in elevation the air conditioning unit of the present invention installed therein;

Fig. 4 is a fragmentary, horizontal section through a portion of the building showing in plan the air condtioning unit of the present invention; and

Fig 5 is a diagrammatic view showing the electrical and refrigerant connections, as well as the relative positions of the two condensers and of the two evaporators.

Referring more particularly to the drawings, the air conditioning unit 8 of the present invention may include a casing having a bottom or base member 10, a top wall 12, side walls 14 and 16 and end walls 18 and 20. The casing may also include an intermediate division wall or bulkhead 22 dividing the interior of the unit into a condenser compartment 24 and an evaporator compartment 26. The end wall 18 has an opening 28 therein which occupies most of the area of the end wall, and a condenser structure 30 is positioned within the condenser compartment 24 so as to extend entirely across, i. e., substantially throughout, the opening 28. The end wall 20 at the other end of the casing has upper and lower openings 32 and 34, respectively. Both the openings 32 and 34 are surrounded by flanges for receiving air ducts and extend the greater part of the distance across the end wall 20.

An evaporator structure 36 is positioned within the evaporator compartment 26 so as to extend entirely across, i. e., substantially throughout, the upper opening 32. An upper duct 38 is connected to the flange surrounding the opening 32 and is adapted to carry cooled air to the rooms to be cooled. An air filter 40 of any known or suitable type may also be positioned in the evaporator chamber 26 so as to extend across and fill the opening 34. A lower duct 42 may be connected to the flange surrounding the opening 34 for returning air from the rooms being cooled. The evaporator compartment 26 also contains a centrifugal fan having a rotor 44 mounted on the shaft 46 of a motor 48 positioned in the condenser compartment with the shaft 46 extending through the division wall 22. The fan rotor 44 is positioned within a scroll or volute casing 50 having an inlet 52 concentric with the shaft 46 and an upwardly directed discharge opening 54 in the top of the casing 50. The evaporator chamber 26 has partition members 56 and 58 therein isolating the inlet 52 of the fan casing 50 from the discharge opening 54 thereof so that air is drawn into the fan casing 50 through its inlet 52 from the opening 34 and duct 42 and is discharged from the opening 54 of the fan casing through the evaporator structure 36, the opening 32 and the duct 38.

The fan motor 48 is secured to a standard 60 in the condenser chamber 24, which in turn is secured to the base 10 of the casing of the air conditioning unit 8. A fan 62 of the radial blade type is mounted on the end of the motor shaft 46 remote from the rotor 44 and is directed to cause air to flow out of the casing of the air conditioning unit through the condenser structure 30 and opening 28. Such air enters the casing of the air conditioning unit through louvers 64 in the side walls 14 and 16 of the unit and serves to cool the condenser structure. The fan 62 is provided at its periphery with a slinger ring 66 and has a shroud or baffle 68 surrounding its rim and positioned between the slinger ring and the motor 48. The lower portion of the shroud 68, in conjunction with the lower portion of the end wall 18 of the casing of the air conditioning unit, provides a tray or reservoir for condensed water from the evaporator structure 36. The evaporator structure 36 has a bottom wall portion 70 which forms a trough extending laterally of the casing of the air conditioning unit below the evaporator elements of the evaporator structure 36. A flexible tube 72 extends from an opening in the lower portion of the trough 70 through an opening in the shroud 68 and into the reservoir formed between the shroud 68 and the end wall 28. Water condensing upon the elements of the evaporator structure 36 is thus conducted to the condenser structure and is picked up by the slinger ring 66 on the fan 62 so as to be distributed over the elements of the condenser structure 30.

Separate hermetically sealed motor-compressor units 74 and 76 are also positioned in the condenser compartment 24 and each may be any known or suitable unit containing an electric motor and a compressor. The two motor-compressor units 74 and 76 each form part of separate cooling systems. Thus, the compressed refrigerant gas from the compressor motor unit 74 is delivered through a pipe 78 to a condenser section 80 in the upper portion of the condenser structure 30, and condensed liquid refrigerant is then delivered from such condenser section 80 through a pipe 82 and capillary tube 84 to an evaporator section 86 in the upper portion of the evaporator structure 36. Cold refrigerant gas evaporated from the liquid refrigerant in the evaporator section 86 is then returned by a pipe 88 to the motor-compressor unit 74, the capillary tube 84 being positioned closely adjacent the pipe 88 for the gas returning to the unit 74. Similarly, the other motor-compressor unit 76 may be connected by the pipe 90 to a second condenser section 92 in the lower portion of the condenser structure 30 for delivering compressed refrigerant gas to such section. Condensed liquid refrigerant may be delivered from the condenser section 92 through a pipe 94 and capillary tube 96 to a second evaporator section 98 in the lower portion of the evaporator structure 36. Cold refrigerant gas evaporated from the liquid refrigerant in the evaporator section 98 may be returned through a pipe 100 to the motor-compressor unit 76, the pipe 100 being positioned closely adjacent the capillary tube 96. There are thus two separate cooling systems which, as discussed below, may be operated together or only one of them operated at a given time.

In the preferred construction, the two motor-compressor units 74 and 76 are of the same size or capacity, and the same is true of the two evaporator sections 86 and 98. However, the two condenser sections 80 and 92 are of different size, the lower section 92 being much smaller than the upper section 80 although having substantially the same condenser capacity because of the better contact with the water from the evaporator structure. Where the two motor-compressor units have the same capacity, the lower condenser section may be approximately one half the size of the upper section, i. e., be one third of the total condenser structure. The evaporators and condensers may be of any known or suitable construction having passages for the refrigerant and metal fins or metal plates



providing heat exchange areas for contact with the air being cooled or heated. Thus, for motor-compressor units of equal capacity, the two evaporator sections will have substantially equal heat exchange area for contact with air, while the lower condenser section will have approximately one half as much heat exchange area for contact with air as the upper section or approximately one third the total heat exchange area of the condenser structure. It is, of course, possible to employ motor-compressor units of different capacity in the two systems, in which case the heat exchange areas of the corresponding evaporator sections will be substantially proportional to the capacities of the motor-compressor units, but the ratio of the heat exchange area of the lower condenser section to the capacity of its corresponding motor-compressor unit will be approximately one half of the ratio of the heat exchange area of the upper condenser section to the capacity of its corresponding motor-compressor unit.

In general, it is desirable to operate the cooling system which contains the lower condenser section 92 and lower evaporator section 98 when one of the cooling systems is being operated by itself, i. e., under light load conditions. Air passing through the upper evaporator section 86 is not cooled, but any air passing through the lower evaporator section 98 is cooled substantially to the same extent as if both cooling systems were in operation so that water vapor is condensed and cold water delivered through the tube 72 to the reservoir below the lower condenser section 92. This water is thrown upon both condenser sections, but to a greater extent upon the lower condenser section and, in any event, substantially all of the water delivered to the condenser structure from the evaporator structure is eventually evaporated upon the lower condenser section 92 when such section only is in operation.

A thermostat unit 102 is shown diagrammatically in Fig. 5 and is arranged to cause operation of the cooling system containing the lower condenser and evaporator sections under light load conditions and to cause operation of both cooling systems under heavier load conditions. The thermostat unit 102 is shown, by way of example, as being of the type having a bellows 104 containing a material which expands upon rise in temperature, the bellows being positioned between a stationary frame member 106 and a pivoted contact member 108 resiliently urged toward the bellows 104 by a tension spring 110. The contact member 108 may be arranged to first engage a contact 112 upon rise in temperature to complete a circuit from an electric line 114 through an off-and-on switch 116 to the fan motor 48 and to the motor-compressor unit 76 for the system including the lower condenser section 92 and lower evaporator section 98. Further movement of the contact member 108 with further increase in temperature causes it to engage contact 118 to also complete a circuit from the line 114 to the motor-compressor unit 74 in the cooling system including the upper condenser section 80 and upper evaporator section 86. Thus, the cooling system including the lower sections of the condenser and evaporator is operated under light loads and both cooling systems are operated under heavier loads. It is apparent that the thermostat unit may be of any suitable or known type, for example, one of the bimetallic type instead of the bellows type shown, which will close two contacts in succession as the temperature increases. It will also be apparent that the thermostat unit may be adjustable, as is well known in the art, for different temperatures and for different temperature differences between the closing of the two contacts. Such thermostat unit may be positioned in any suitable place, for example, in one of the rooms to be cooled, or in the return duct 42 or in the evaporator chamber 26 so as to be contacted with air returned from the rooms before such air is passed through the evaporator.

As shown most clearly in Figs. 3 and 4, the air conditioning unit 8 of the present invention may be positioned in the attic of a building between the roof 120

and the ceiling **122** of a room to be cooled. The end wall **18** of the air conditioning unit **8** may be positioned against the wall **126** of the attic with its opening in alignment with louvers **128** in the wall **126**, the air conditioning unit being shown as resting upon the floor **130** of the attic although it is understood that the unit may be mounted upon any suitable support or platform. The louvers **128** should be considerably wider than the air conditioning unit **8** or, preferably, additional louvers **132** may be provided at each side of the air conditioning unit. Baffle members **134** extending between the side walls of the unit **8** and the wall **126** of the attic in combination with top baffle members **136** and the floor **130** in the attic provide closed passageways for entrance of outside air through the louvers **132** and louvers **64** into the interior of the casing of the unit **8**. The fan **66** forces this air out through the condenser structure **30**, thus setting up a circulation of cooling air for such condenser structure, and at the same time throws water from the evaporator structure **36** upon the heat exchange surfaces of the condenser structure.

The upper duct **38** for cooled air may extend in any desired direction in the attic and may have branch ducts **138** discharging cooled air into rooms to be cooled. Similarly, the duct **42** for return air may be provided with branch ducts **140** for withdrawing warmed air from the rooms. A branch duct **138** is shown as extending downwardly through the interior of a partition wall **142** to a register **144**, and a branch duct **140** is shown as being connected to an opening through the ceiling **122** of the room, but it will be apparent that the branch ducts can be arranged in any desired or suitable manner to introduce cooled air into a room and exhaust warmed air therefrom.

I claim as my invention:

1. In an air conditioning unit, a casing having an opening in a vertical wall thereof, a condenser structure within said casing and extending across said opening, said condenser structure having an upper section and a lower section, two separate cooling systems each having a motor-compressor unit and an evaporator positioned in said casing, one of said condenser sections being connected in series in one of said systems and the other of said condenser sections being connected in series in the other of said systems, a fan for directing air to be cooled through said evaporators to cool said air and cause water vapor to be condensed on said evaporators, a water reservoir below said condenser structure, means for collecting condensed water from said evaporators and delivering it into said reservoir, and a fan adjacent said condenser structure for directing cooling air outwardly therethrough, said fan having a slinger ring dipping into said reservoir to throw said water upon the heat exchange areas of said condenser structure in contact with said cooling air, said lower condenser section having substantially less of said heat exchange area in proportion to the capacity of its associated motor-compressor unit and evaporator than said upper condenser section.

2. In an air conditioning unit, a casing having an opening in a vertical wall thereof, a condenser structure within said casing and extending across said opening, said condenser structure having an upper section and a lower section, two separate cooling systems each having a motor-compressor unit and an evaporator positioned in said casing, one of said condenser sections being connected in series in one of said systems and the other of said condenser sections being connected in series in the other of said systems, a fan for directing air to be cooled through said evaporators to cool said air and cause water vapor to be condensed on said evaporators, a water reservoir below said condenser structure, means for collecting condensed water from said evaporators and delivering it into said reservoir, and a fan adjacent said condenser structure for directing cooling air outwardly therethrough, said fan having a slinger ring dipping into said reservoir to throw said water upon the heat exchange areas of said condenser structure in contact with said cooling air, said motor-compressor units and associated evaporators having substantially equal capacities, and said lower condenser section having substantially less of said heat exchange area than said upper section.

3. In an air conditioning unit, a casing having an opening in a vertical wall thereof, a condenser structure within said casing and extending across said opening, said condenser structure having an upper section and a lower section, two separate cooling systems each having a motor-compressor unit and an evaporator positioned in said casing, said upper condenser section being connected in series in one of said systems and said lower condenser section being connected in series in the other of said systems, a fan for directing air to be cooled through said evaporators to cool said air and cause water vapor to be condensed on said evaporators, a water reservoir below said condenser structure, means for collecting condensed water from said evaporators and delivering it into said reservoir, a fan adjacent said condenser structure for directing cooling air outwardly therethrough, said fan having a slinger ring dipping into said reservoir to throw said water upon the heat exchange areas of said condenser structure in contact with said cooling air, said lower condenser section having substantially less of said heat exchange area in proportion to the capacity of its associated motor-compressor unit and associated evaporator than said upper condenser section, and thermostat means responsive to air to be cooled for causing operation of said other cooling system containing said lower condenser section upon a temperature rise of the air to be cooled and for thereafter causing operation of said one cooling system upon a further temperature rise of the air to be cooled.

4. In an air conditioning unit, a casing having an opening in a vertical end wall thereof, a condenser structure having an upper section and a lower section within said casing and extending across said opening, said casing having an opening in its other vertical end wall, an evaporator structure having an upper section and a lower section extending across the last-mentioned opening, two separate cooling systems, each having a motor-compressor unit, the upper section of said condenser structure and the upper section of said evaporator structure being connected to one motor-compressor unit to form one of said systems and the lower section of said evaporator and the lower section of said condenser being connected to the other motor compressor unit to form the other of said systems, a fan for directing air to be cooled through said evaporator structure to cool said air and cause water vapor to be condensed, a water reservoir below said condenser structure, means for collecting condensed water from said evaporator structure and delivering it to said reservoir, and a fan adjacent said condenser structure for directing cooling air outwardly therethrough, said fan having a slinger ring dipping into said reservoir to throw said water over said condenser structure, said motor-compressor units and associated evaporator sections being of substantially equal capacity and said evaporator sections having substantially equal heat exchange areas for contact with the air being cooled, said upper condenser section having a heat exchange area for contact with cooling air of the order of twice the heat exchange area of the lower condenser section.

5. In an air conditioning unit, a casing having an opening in a vertical end wall thereof, a condenser structure having an upper section and a lower section within said casing and extending across said opening, said casing having an opening in its other vertical end wall, an evaporator structure having an upper section and a lower section extending across the last-mentional opening, two separate cooling systems, each having a motor-compressor unit, the upper section of said condenser structure and the upper section of said evaporator structure being con-

nected in series with one of said motor-compressor units to form one of said systems and the lower section of said evaporator and the lower section of said condenser being connected in series with the other of said motor-compressor units to form the other of said systems, a fan for directing air to be cooled through said evaporator structure to cool said air and cause water vapor to be condensed, a water reservoir below said condenser structure, means for collecting condensed water from said evaporator and delivering it to said reservoir, and a fan adjacent said condenser structure for directing cooling air outwardly therethrough, said fan having a slinger ring dipping into said reservoir to spray said water upon the heat exchange area of said condenser structure in contact with said cooling air, said lower condenser section having substantially less of said heat exchange area in proportion to the capacity of its associated motor-compressor unit and evaporator section than said upper condenser section.

6. In an air conditioning unit, a casing having an opening in a vertical end wall thereof occupying the major portion of the area of said end wall, a condenser structure having an upper section and a lower section within said casing and extending across and substantially throughout said opening, said casing having an opening in its other vertical end wall, an evaporator structure having an upper section and a lower section extending across the last-mentioned opening, two separate cooling systems, each having a motor-compressor unit, the upper section of said condenser structure and the upper section of said evaporator structure being connected to one motor-compressor unit to form one of said systems and the lower section of said evaporator and the lower section of said condenser being connected to the other motor compressor unit to form the other of said systems, a fan for directing air to be cooled through said evaporator structure to cool said air and cause water vapor to be condensed, a water reservoir below said condenser structure, means for collecting condensed water from said evaporator structure and delivering it to said reservoir, a fan adjacent said condenser structure for directing cooling air outwardly therethrough, said fan having a slinger ring dipping into said reservoir to throw said water over said condenser structure, said motor-compressor units being of substantially equal capacity and said evaporator sections having substantially equal heat exchange areas for contact with the air being cooled, the upper condenser section having a heat exchange area for contact with cooling air fo the order of twice the heat exchange area of the lower condenser section, and a thermostatic unit responsive to the temperature of air to be cooled for causing operation of said other motor-compressor upon a rise in temperature of the air to be cooled and operation of said one motor-compressor upon a further rise in temperature of the air to be cooled.

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