Oct. 1, 1940. E. E. ARNOLD ET AL 2,216,427

AIR CONDITIONING APPARATUS

Original Filed June 19, 1935 2 Sheets-Sheet 1

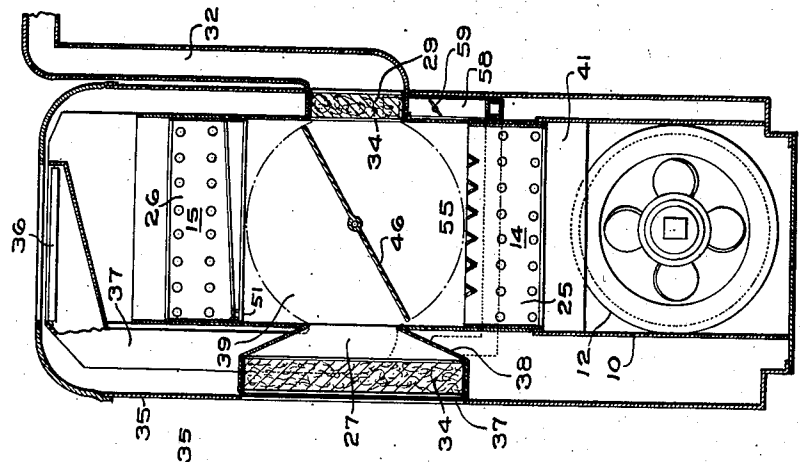


FIG. 2.

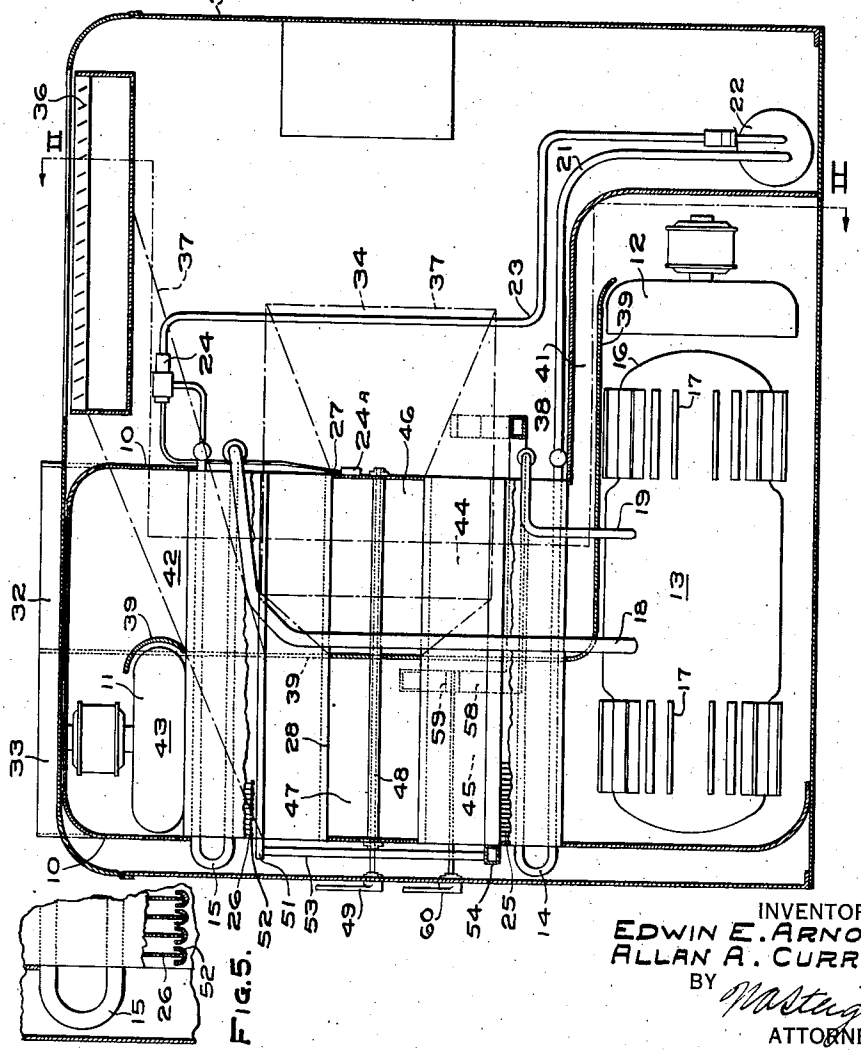


FIG. 1.

FIG. 5.

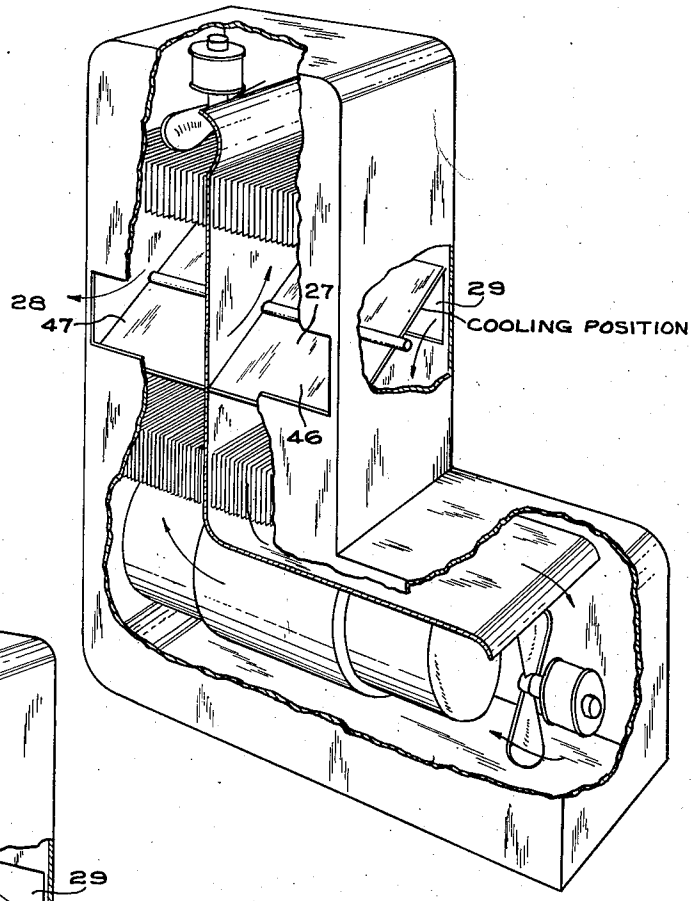
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FIG. 3.



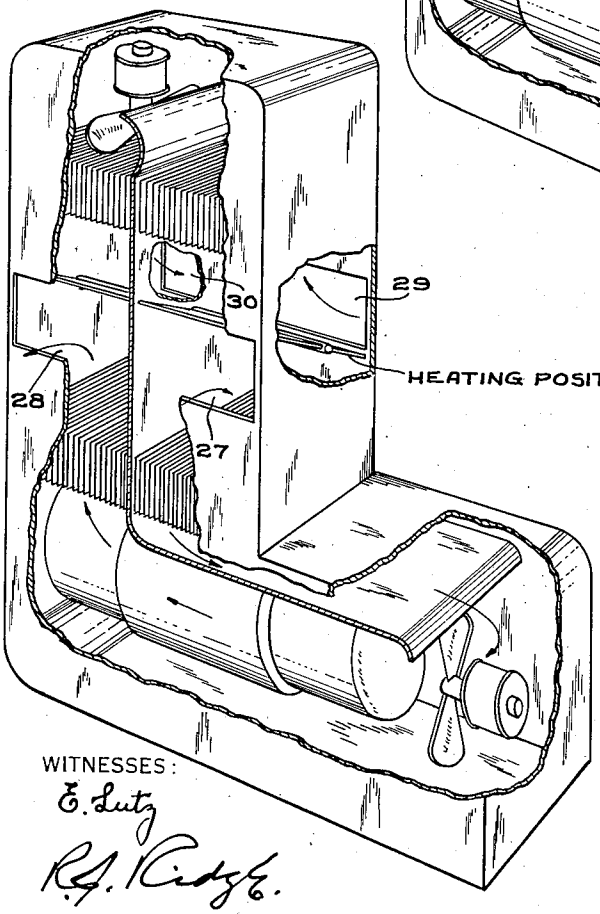


FIG. 4.

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2,216,427

AIR CONDITIONING APPARATUS

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Application June 19, 1935, Serial No. 27,308
Renewed October 2, 1936

10 Claims. (Cl. 62—140)

Our invention relates to air conditioning apparatus and more particularly to a self-contained unit for treating the air in an enclosure, and it has for an object to provide improved apparatus of this kind.

A further object of our invention is to provide a self-contained air conditioning unit which will effectively increase or decrease the sensible and latent heat of the air being conditioned.

A still further object of our invention is to provide improved apparatus which may be adjusted at will for conversion from cooling to heating and vice versa, and which effectively removes moisture precipitated from the air being cooled or adds a certain amount of moisture to the air when being heated.

In practicing our invention, a casing structure is provided for housing all of the elements for translating and treating the air in an enclosure, so that a self-contained unit, adapted for installation within the enclosure, is obtained. The casing is provided with a plurality of openings through which streams of air are passed; one of said streams containing the air being conditioned and the other stream constituting the cooling medium for the refrigerating apparatus during periods when cooling of the air in the enclosure is effected and constituting a source of heat during periods when the air in the enclosure is heated.

The enclosed refrigerating apparatus functions, at times, to cool the air in the enclosure and, by transposing the air streams, to heat the air at other times. The refrigerating apparatus includes an evaporator arranged preferably adjacent the top of the casing, a condenser and a compressor disposed at the bottom of the casing. The condenser is preferably disposed beneath the evaporator and adjacent the compressor. The aforementioned openings are arranged in the casing between the evaporator and condenser, and baffle means cooperates therewith to direct outside air over the condenser and inside or room air over the evaporator during cooling operation. The air in the room may be heated by adjusting the baffle means to a second position, wherein outside air passes over the evaporator and the room air over the condenser.

Moisture precipitated from the cooled air is drained to the stream of air passed in heat exchanging relation with the condenser and is vaporized therein so that, during cooling operation the treated air is dehumidified and during heating operation the treated air is humidified.

These and other objects are effected by our invention as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a vertical sectional view taken longitudinally through a self-contained air conditioning device constructed in accordance with our invention;

Fig. 2 is a transverse, vertical, sectional view of the apparatus of Fig. 1 and is taken along the line II—II thereof;

Figs. 3 and 4 are diagrammatic, perspective views of our improved device and show the adjusting means moved to positions for cooling and heating operations, respectively; and,

Fig. 5 is an enlarged view of a detail shown in Fig. 1.

Referring now to the drawings, our improved unit includes an inner casing structure 10 for housing air translating devices such as, for example, propeller type blowers 11 and 12 and the elements of a refrigerating system for treating air. The latter includes a compressor mechanism 13, a condenser 14 and an evaporator 15. The compressor mechanism 13 which we have disclosed is of the hermetically sealed type and includes motor driven compressors (not shown), inclosed by an air cooled casing 16. Fins 17 may be provided for facilitating the radiation of heat from the casing 16.

The refrigeration system operates on the well known compressor-condenser-expander cycle, in which refrigerant vapor is withdrawn by the compressor mechanism 13 from the evaporator 15 through a conduit 18 and is compressed to a relatively high pressure. A conduit 19 conveys the compressed refrigerant gas to the condenser 14 in which condensation thereof is effected, the heat of condensation being transmitted to the condenser 14. Liquid refrigerant flows from the condenser 14 by means of a conduit 21 to a reservoir 22 and then through a conduit 23 to an expansion device 24 under the control of temperature sensitive element 24—A where its pressure is reduced, prior to its admission into the evaporator 15. The liquid is subjected to the low pressure maintained in the evaporator by the suction of the compressor and evaporates, subtracting heat from the evaporator 15 in a well-known manner. This completes the cycle which is repeated as long as the compressor mechanism 13 operates. Fins 25 and 26 may be provided for the condenser 14 and the evaporator 15, respectively, for increasing their heat transfer surfaces.

A plurality of openings 27 to 30 inclusive are arranged in the casing structure 10 intermediate

the condenser 14 and the evaporator 15. These openings are more clearly shown in Figs. 3 and 4. Openings 27 and 28 communicate with the enclosure being air conditioned and openings 29 and 30 communicate, by means of ducts 32 and 33, respectively (Figs. 1 and 2) with a source of air exterior of the enclosure. Usually, the ducts 32 and 33 extend through a wall opening to the outside atmosphere.

An outer shell 35 is preferably arranged around the inner casing 10 and includes an air outlet opening 36 communicating with the room and connected by a duct 37 with the opening 28 in casing 10. The shell 35 includes an opening 37 communicating with the room and connected by duct 38 with the opening 27; the opening 37 constituting an inlet opening for air to be conditioned. Air filters 34 may be arranged in the ducts 32 and 38 for cleaning the air admitted to the casing 10.

A vertical partition 39 is disposed within the casing 10 and extends from above the evaporator 15 downwardly and intersects the condenser 14. Below the condenser 14, the partition 39 extends horizontally above the compressor mechanism 13 and blower 12 and defines with the casing 10 a horizontal passage 41 connecting at one end with the inlet of the blower 12. The partition 39 divides the upper, or evaporator portion of the casing into first and second air passages 42 and 43; within and across both of which the evaporator 15 is disposed. The blower 11 withdraws air from the passage 42 and discharges into passage 43.

The partition 39 divides the portion of the casing 10 adjacent the condenser 14 into first and second passages 44 and 45; the former of which communicates with the passage 41. The condenser 14 is disposed in and across both of the passages 44 and 45.

A movable damper 46 is arranged in the space intermediate the passages 42 and 44 and between the openings 27 and 29, which space may be referred to as a damper chamber. A damper 47, movable with the damper 46, is similarly arranged in the space or damper chamber intermediate the passages 43 and 45 and between the openings 28 and 30. The dampers 46 and 47 are preferably carried by a common shaft 48 journalled in the casing 10 and provided with an adjusting handle 49 disposed exteriorly of the shell 35.

Means is provided for disposing of water precipitated from the air cooled by the evaporator 15 and may include a small trough 51 arranged below and to one side of the evaporator 15. The lower edges of the fins 26 of the evaporator 15 may be inclined, the lowest point of the fins being disposed above the trough 51. Moisture collecting on the fins 21 runs downwardly to the lowermost edge and, due to capillarity, moves along the lower inclined edge to the point above the trough 51. Moisture collects at this point and drips into the trough 51. Relatively narrow spouts may be formed on the lower edges of the fins 26 for conducting moisture to the trough 51 as shown at 52 in Figs. 1 and 5.

Water drains from the trough 51 through a pipe 53 to a header 54 disposed at one side of and above the condenser 14. A plurality of spaced channels 55 communicate with the header 54 for draining water therefrom; which channels extend into the heated air stream above the condenser 14. It will be understood that the air passed in heat exchanging relation with the condenser 14 is heated thereby and its capacity for absorbing water is relatively high. As water fills the channels 55 and tends to flow over the edges thereof, it is vaporized into the air stream and carried away thereby.

Operation

Assume it is desired to cool the air in the enclosure or room in which the unit is disposed. The dampers 46 and 47 are adjusted to the position shown in Fig. 3 and operation of the refrigerating system is initiated. Air from the enclosure is drawn by the blower 11 through the filter 34, the duct 38 and the opening 27 into the casing 10. The damper 46 causes the air to pass upwardly through passage 42 and into heat exchanging relation with the portion of the evaporator 15 disposed in the passage 42. The blower 11 then forces the air through passage 43 and across the other portion of the evaporator 15. Heat is abstracted from the air by the cool evaporator so that cooled air is deflected through the opening 28 by the damper 27 and passes to the enclosure by means of the duct 37 and the outlet opening 36.

During periods of air cooling, the condenser 14 and compressor mechanism 13 are cooled by air drawn from the atmosphere. This stream of cooling air is translated by blower 12 and is conveyed to the casing 10 by means of the duct 32, the filter 34 and the opening 29. The damper 46 deflects the outside cooling air downwardly between the channels 55 and into heat exchanging relation with the portion of the condenser 14 arranged in the passage 44. The stream of air passes serially through the passage 41 and blower 12 into heat exchanging relation with the casing 16 of the compressor mechanism 13 and the portion of the condenser 14 disposed in passage 45. The heated air passes between the channels 55 and is deflected through opening 30 by the damper 47 so that it is discharged to the outside atmosphere by means of the duct 33.

As described heretofore, moisture which is precipitated from the air being cooled, flows to the channels 55 and is evaporated into the stream of air discharged to the outside atmosphere. The conditioned air discharged through the opening 36 to the room is cooled, dehumidified, and filtered. It may be desirable to add fresh outside air to the conditioned air for physiological reasons, and in order to effect this addition, we provide a duct 58 having a damper 59 arranged therein. The duct 58 provides communication between the two streams of air as shown in Fig. 1. Outside air enters the duct 58 adjacent opening 30 and is delivered to the duct 38 wherein it is mixed with the air to be conditioned, as best shown in Fig. 2. The damper 59 may be adjusted by means of a handle 60 arranged exteriorly of the shell 35.

For winter or cool weather operation, the unit may be operated for heating and humidifying the air in the enclosure. The refrigerating system is operated and the dampers 46 and 47 are adjusted to the position shown in Fig. 4, whereby the stream of air being conditioned passes in heat exchanging relation with the condenser 14 and the stream of air from without the enclosure passes over the evaporator 15. Heat abstracted from the air contacting the evaporator 15 is given off by the condenser 14, so that the air delivered to the enclosure by the blower 12 is heated. In this connection it will be seen that the blower 12 circulates the air to be conditioned during heating operation and that the blower 11 circulates the air from without the enclosure.

This is a transposition of their operation during the cooling cycle.

Humidification of the conditioned air is effected during the heating cycle as moisture which is precipitated from the outside air by the evaporator 15 flows to the channels 55 and is absorbed by the heated air. Fresh or outdoor air may be added in the same manner as described heretofore by opening damper 59 in the fresh air duct 58.

From the foregoing it will be apparent that we have provided a self-contained air conditioning unit for cooling and dehumidifying or for heating and humidifying air within an enclosure, and which may be readily adjusted from one operation to the other by shifting or transposing the air streams passing through the conditioner. Furthermore, objectional connections such as, for example, water connections and water drains have been eliminated. While we have shown a refrigerating system of the compressor condenser expander type for conditioning the air, it will be understood that other forms of refrigerating systems having heat absorbing and heat radiating elements may be employed.

While we have shown our invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and we desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What we claim is:

1. In air conditioning apparatus, the combination of a casing structure having an outside air inlet opening, a room air inlet opening, an outside air outlet opening and a room air outlet opening formed therein, a refrigerant evaporator arranged on one side of said openings and within said casing, a refrigerant condenser arranged on the opposite side of said openings and within the casing, first and second air translating means associated respectively with the evaporator and the condenser, a damper arranged between said air inlet openings, a second damper arranged between said air outlet openings, and means for selectively adjusting the dampers to a first position wherein the outside air inlet and outlet openings communicate with the condenser and the room air inlet and outlet openings communicate with the evaporator and to a second position wherein the outside air inlet and outlet openings communicate with the evaporator and the room air inlet and outlet openings communicate with the condenser.

2. In air conditioning apparatus, the combination of a casing structure having an outside air inlet opening, a room air inlet opening, an outside air outlet opening and a room air outlet opening formed therein, an evaporator element arranged within said casing structure and above said openings, a condenser element disposed within the casing structure and below said openings, first and second means for respectively translating air in heat exchanging relation with said evaporator and condenser, a damper arranged intermediate said air inlet openings, a second damper arranged intermediate said air outlet openings, and means for selectively adjusting the dampers to a position in which the outside air inlet and outlet openings communicate with the condenser element and the room air inlet and outlet openings communicate with the evaporator element, and to a second position wherein the outside air inlet and outlet openings communicate with the evaporator element and the room air inlet and outlet openings communicate with the condenser element.

3. Air conditioning apparatus as claimed in claim 2, having means for conveying air from the air stream passing through said outside air openings to the stream of air passing through said room air openings.

4. The apparatus as claimed in claim 2 having means for conveying moisture precipitated from the stream of air cooled by the evaporator to the stream of air contacting the condenser for evaporation therein.

5. In air conditioning apparatus, the combination of a casing structure, an evaporator arranged adjacent the top of said casing structure, a condenser disposed below said evaporator, a compressor for circulating refrigerant through the condenser and evaporator and disposed adjacent the condenser, a blower for circulating air in heat exchanging relation with the evaporator, a second blower for circulating air in heat exchanging relation with the condenser and compressor; said casing including an outside air inlet opening, a room air inlet opening, an outside air outlet opening and a room air outlet opening, disposed intermediate the condenser and evaporator; baffle means arranged between said air inlet openings and between the air outlet openings, means for adjusting the baffle means to a position wherein the outside air openings communicate with the condenser and the room air openings communicate with the evaporator, and to a second position wherein the outside air openings communicate with the evaporator and the room air openings communicate with the condenser, means for conveying air from the stream passing through the outside air openings to the stream passing through the room air openings, and means for conveying moisture precipitated from the air cooled by the evaporator to the stream of air heated by the condenser for vaporization therein.

6. In a unit air conditioner, the combination of two adjacent damper chambers having a front and a rear and having outside air inlet and outlet openings in the rear and room air inlet and outlet openings in the front, a condenser element, an evaporator element, one of said elements being located below the damper chambers and the other above the damper chambers, means providing a first passage for air from one damper chamber downwardly through one part of the lower element and then upwardly through another part thereof to the second damper chamber, means providing a second passage for air from one damper chamber upwardly through one part of the upper element and then downwardly through another part thereof to the other damper chamber, and dampers in said damper chambers movable to a position inclined rearwardly placing the outside air openings in communication with the first passage and the room air openings in communication with the second passage, or to a position inclined forwardly placing the room air openings in communication with the first passage and the outside air openings in communication with the second passage.

7. In apparatus for air conditioning an enclosure, the combination of an evaporator, an air cooled condenser disposed at a level below the evaporator, means for draining moisture condensed on the surfaces of the evaporator and delivering the same to the air cooled surfaces of

the condenser, and means for selectively conveying air for the enclosure in contact with the evaporator and outdoor air in contact with the condenser or conveying air for the enclosure in contact with the condenser and outdoor air in contact with the evaporator.

8. In air conditioning apparatus, the combination of a refrigerating system including an evaporator, a compressor and a condenser, damper means movable to first and second positions, means for effecting flow of a first stream of air from outdoors, over the condenser in the first position of said damper means and over the evaporator in the second position of said damper means, and then to outdoors, means for effecting flow of a second stream of air from said enclosure, over the evaporator in the first position of the damper means and over the condenser in the second position of the damper means, and then to said enclosure, and means operable in either position of said damper means for diverting a portion of the air from said first stream and mixing the same with the air in said second stream.

9. In air conditioning apparatus, the combination of a casing structure comprising an inlet damper space having room air and outside air inlet openings disposed on opposite sides thereof and an outlet damper space having room air and outside air outlet openings disposed on opposite sides thereof, said casing further comprising evaporator and condenser passages communicating with each of said damper spaces on opposite sides thereof intermediate the room air and outside air openings, an evaporator and a condenser disposed in said evaporator and said condenser passage, respectively, a compressor connected in refrigerant flow relation with said evaporator and said condenser, dampers in said damper spaces mounted substantially on a common axis of rotation extending through both damper spaces and connected to operate in unison, said dampers being movable from a first position wherein the evaporator passage communicates with the room air inlet and outlet openings and the condenser passage communicates with the outdoor air inlet and outlet openings, and to a second position wherein the evaporator passage communicates with the outside air inlet and outlet openings and the condenser passage communicates with the room air inlet and outlet openings, and means for translating air through the several paths thus provided.

10. Air conditioning apparatus as set forth in claim 9 wherein the room air openings and the outside air openings of the two chamber spaces are arranged substantially in alignment in directions parallel to said axis of rotation.

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