Dec. 5, 1944. R. E. GOULD 2,364,287

REFRIGERATING APPARATUS

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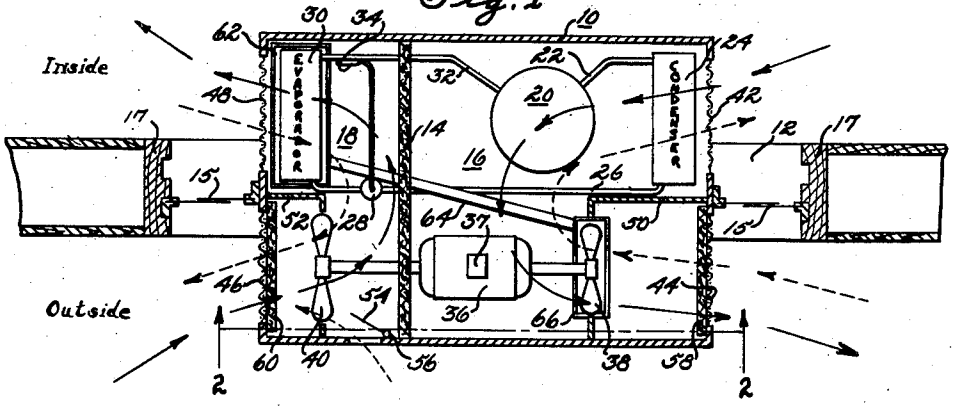
Fig. 1



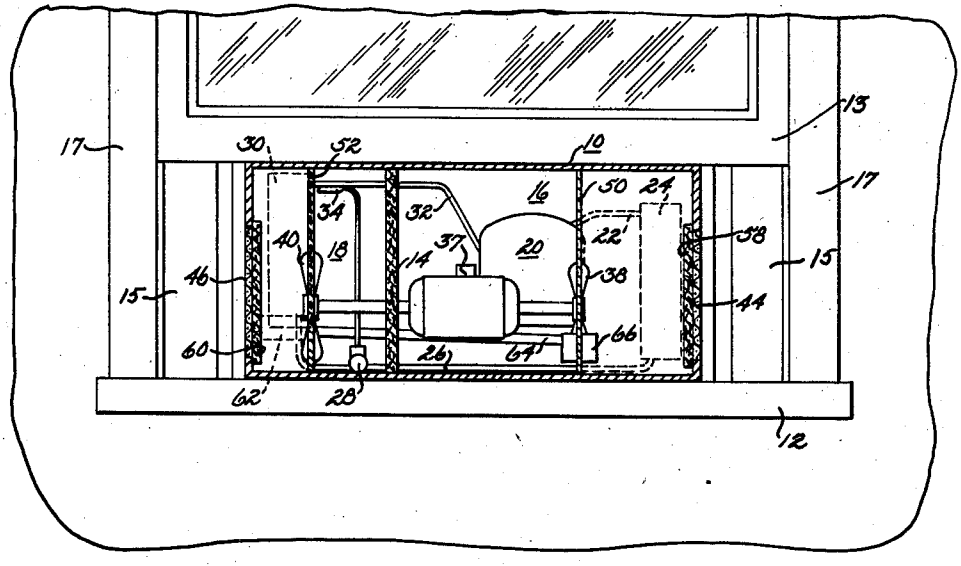


Fig. 2

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Fig. 3

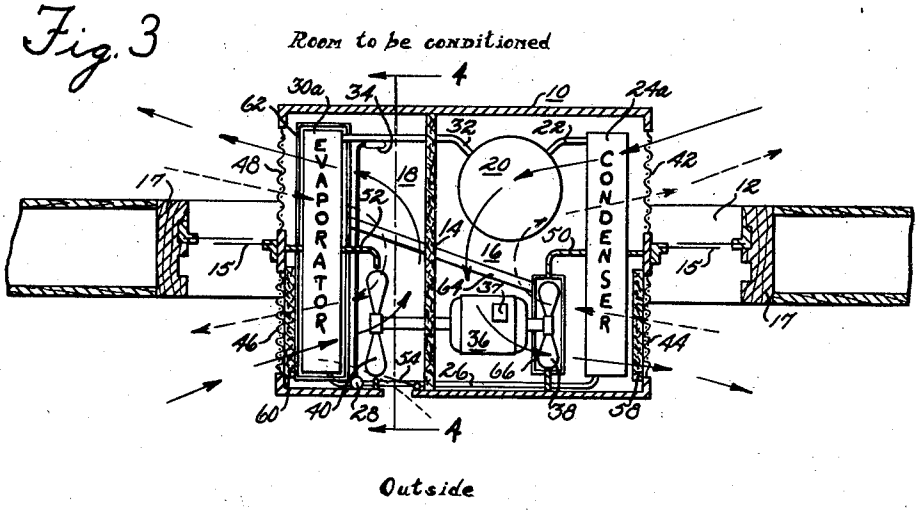
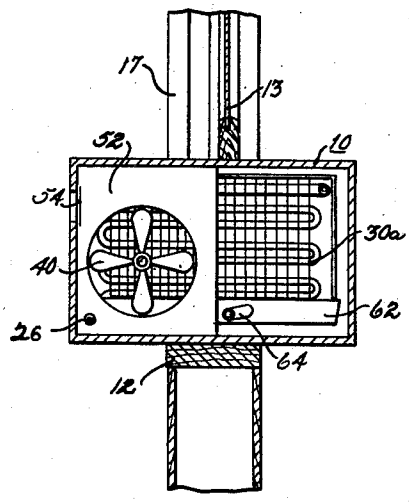


Fig. 4



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REFRIGERATING APPARATUS

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Application July 25, 1941, Serial No. 404,060

7 Claims. (Cl. 62—129)

This invention relates to refrigerating apparatus and more particularly to an improved arrangement for conditioning air.

One object of this invention is to provide a self-contained air conditioning unit which is capable of supplying conditioned air to an enclosure during hot weather and also during cool weather.

Another object of this invention is to provide a simplified arrangement for reversing the heating and the cooling functions of a refrigeration unit.

Another object of this invention is to provide an improved arrangement for maintaining the conditioned space at a pressure slightly higher than that outside of the conditioned space.

A further object of this invention is to provide an improved arrangement for varying the amount of air circulated in thermal exchange with a heat exchange element.

Still another object of this invention is to provide a simple arrangement for returning moisture to the air in a conditioned space during the heating cycle when using a reverse cycle system.

A further object of this invention is to provide an air conditioning unit in which fresh air only is conditioned and in which conditioned air only is used for cooling the refrigerant condenser.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a horizontal sectional view showing the arrangement of elements in an air conditioning unit embodying my invention;

Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a view somewhat similar to Fig. 1 showing a modified arrangement of the refrigerating apparatus; and

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 3.

Referring now to the drawings, reference numeral 10 designates a cabinet which is adapted to be mounted in a wall opening such as a window. As shown in Fig. 1, the cabinet 10 rests on the window sill 12.

Reference numeral 15 designates an adjustable means for filling in the space between the side wall of the cabinet 10 and the window frame 17. Inasmuch as the cabinet 10 is adapted to rest directly upon the window frame 12 and since the main window sash 13 may be lowered into engagement with the top surface of the cabinet 10, no special means have been provided for filling in above or below the cabinet 10. A dividing wall 14 separates the cabinet 10 into a condenser compartment 16 and an evaporator compartment 18. A motor-compressor unit 20 is mounted directly within the condenser compartment 16 and is adapted to discharge compressed refrigerant through the line 22 into the condenser 24. The condensed refrigerant flows from the condenser 24 through the liquid refrigerant line 26 leading to a conventional thermostatic expansion valve 28 which controls the flow of refrigerant to the evaporator 30. The refrigerant vaporized in the evaporator 30 is returned to the motor-compressor unit 20 through the vapor line 32. A thermostatic bulb 34 placed in thermal exchange with the refrigerant line 32 throttles the flow of refrigerant through the expansion valve 28 when too much liquid refrigerant accumulates in the evaporator 30 in accordance with well known practice. While I have shown a thermostatic valve for controlling the flow of refrigerant to the evaporator, it is apparent that any other suitable type of refrigerant flow control may be used such as a fixed restrictor.

A motor 36, which is adapted to be operated in either direction desired, is mounted within the condenser compartment 16 and is adapted to drive the condenser fan 38 and the evaporator fan 40. Reference numeral 37 designates any conventional means for reversing the direction of rotation of the motor 36. During the summer season when cooling is required, the motor 36 is operated in a direction whereby the fans 38 and 40 cause air to flow in the direction indicated by the full line arrows in Fig. 1. During this cooling season, the evaporator fan 40 circulates air to be conditioned over the evaporator in the direction shown by the full line arrows shown in Fig. 1. Thus, outside air enters the evaporator compartment 18 through the opening 46 and discharges into the room to be conditioned through the opening 48. As shown by the full line arrows, air from the room to be conditioned enters the condenser compartment through the inlet 42 and discharges from the condenser compartment through the outlet 44. Reference numeral 50 designates a baffle for directing the flow of air through the condenser compartment and reference numeral 52 designates a somewhat similar baffle for directing the flow of air through the evaporator compartment.

The capacity of the evaporator fan 40 is slightly greater than the capacity of the condenser fan 38 whereby the amount of outside air intro-

duced into the conditioned space by the evaporator fan 40 is slightly greater than the amount of room air which is withdrawn by the condenser fan 38. By virtue of this construction the pressure within the room will be sufficiently greater than the pressure outside the room to prevent any appreciable infiltration of unconditioned air into the conditioned space through door cracks, etc.

It is obvious that when the air flows in the direction indicated by the solid line arrows fresh air only is caused to circulate over the evaporator and is discharged into the space to be conditioned at a reduced temperature and it is also obvious that a slightly smaller quantity of conditioned air from the room is circulated over the condenser and is discharged to the outside. During the heating cycle, however, air from the enclosure is caused to circulate in thermal exchange with the evaporator so as to give up heat to the refrigerant in the evaporator and is thereafter discharged to the outside in a cooled condition as indicated by the dotted arrows. During this heating cycle outside air is introduced into the condenser compartment and is heated by the condenser before being discharged into the space to be conditioned.

A damper 54 which is pivotally mounted as at 56 so as to be free to swing inwardly whenever the pressure within the evaporator compartment is less than the pressure outside the evaporator compartment serves to prevent the evaporator fan 40 from withdrawing a greater amount of air from the conditioned space than is introduced into the conditioned space by the condenser fan 38. It will be observed that during the cooling cycle the pressure exerted on the inner face of the damper 54 will be greater than the atmospheric pressure exerted on the outside face of the damper whereby the damper 54 will remain closed during the cooling cycle. During the heating cycle, however, the suction of the fan 40 will cause the damper 54 to open whereby a considerable portion of the air circulated by the fan 40 will come from the outside. By properly designing the capacity of the damper 54, the amount of air circulated into the conditioned space during the heating cycle by the fan 38 may be greater than the amount of air withdrawn from the conditioned space by the fan 40 even though the fan 40 has a larger capacity than the fan 38.

A filter element 58 is provided adjacent the fresh air opening 44. A similar filter element 60 is provided adjacent the fresh air opening 46 for filtering the fresh air entering the evaporator compartment 18.

A condensate drain pan 62 is mounted beneath the evaporator 30 so as to collect the moisture removed from the air by the evaporator 30. The condensate thus collected in the drain pan 62 flows by gravity through the drain line 64 into the receptacle 66 supported by the baffle 50. The condenser fan 38 dips into the receptacle 66 and serves to atomize the condensate into the air stream flowing through the condenser compartment.

During that portion of the year when it is necessary to cool the air discharged into the conditioned space, a considerable amount of water will be removed from the air by the evaporator and this water will all be discharged into the condenser air stream and will be carried along with the condenser air to the outside atmosphere. During that portion of the year when it is necessary to heat the air supplied to the conditioned space, the moisture removed from the outgoing air by the evaporator 30 will be atomized into the incoming air by the condenser fan 38. The condenser 24 facilitates the complete evaporation of the atomized water before the condenser air is discharged into the room. By virtue of this arrangement, the apparatus serves to both humidify and heat the air during the heating cycle.

In Fig. 3, I have shown a slightly different arrangement in which the evaporator, designated by the reference numeral 30*a*, extends across both openings 46 and 48 and the condenser 24*a* extends across the openings 42 and 44. Like reference numerals have been used for designating like parts in each of the modifications and except when otherwise indicated, the elements shown in Figs. 3 and 4 are similar in construction and function to the corresponding elements shown in Figs. 1 and 2. As shown in Fig. 3, the air flowing over the evaporator first flows over one portion of the evaporator and thereafter flows over the other portion of the evaporator. The same is true of the air flowing over the condenser. This arrangement has several advantages over the arrangement shown in Figs. 1 and 2.

Referring to Fig. 3, it will be observed that during the heating season when the air flows over the evaporator in the direction indicated by the dotted line arrows, the outside air admitted to the evaporator compartment by the damper 54 flows over one portion of the evaporator. This arrangement serves to increase the heating capacity of the unit at such times when the temperature of the outside air is greater than the temperature of the room air which has been cooled in flowing over the first portion of the evaporator. Another advantage of the arrangement shown in Figs. 3 and 4 is that the condensate which is discharged into the condenser air stream by the fan 38 serves to increase the capacity of the condenser during the air cooling cycle.

It will be observed that in both arrangements the water which is atomized by the condenser fan 38 is required to pass over at least one portion of the condenser during the air heating cycle. Thus the condenser serves to more completely atomize or vaporize the water added to the air by the fan 38 before being discharged into the conditioned space.

In order to simplify this disclosure no controls have been shown. It is obvious that the compressor unit and/or the fan motor 36 may be thermostatically controlled in response to changes in either the inside temperature, the outside air temperature or a combination of both. The thermostatic controls may be either dry bulb, wet bulb, effective temperature, or a combination of two or more of the above. By stopping the operation of the motor-compressor unit without stopping the fan motor 36 ventilation alone takes place. The motor 36 may be operated in either direction when ventilation alone is desired.

An appreciable quantity of heat will be dissipated by the motor compressor unit 20 during operation of the refrigerating system. The arrangement of the motor-compressor unit 20, within the cabinet 10, is such that when cooling of the room is required this heat is dissipated into the air flowing to the outside. When heating of the room air is required, this heat is dissipated into the air stream which is discharged into the room. The same is true of the heat dissipated by the fan motor 36. It is apparent, therefore,

that the heat which is given off by the motor compressor unit 20 and the fan motor 36 is used to advantage when heating is required but does not interfere with the efficient operation of the system when cooling of the air is required.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. An all fresh-air air conditioning unit of the window sill type comprising in combination, a casing adapted to be mounted on a window sill of a room to be conditioned, means for dividing said casing into an evaporator compartment and a condenser compartment, said condenser compartment having an opening communicating with said room and an opening communicating with the outside, said evaporator compartment having an opening communicating with the outside and an opening communicating with said room, a refrigerating system including an evaporator in said evaporator compartment and a condenser in said condenser compartment, blower means for normally flowing room air only over said condenser to the outside, a second blower means for normally flowing fresh air only over said evaporator and into said room, said evaporator blower means having a greater capacity than said condenser blower means, means for reversing the direction of rotation of both of said blower means, and means for admitting outside air to the evaporator compartment when said blower means are operating in reverse.

2. An all fresh-air air conditioning unit of the window sill type comprising in combination, a casing adapted to be mounted on a window sill of a room to be conditioned, means for dividing said casing into an evaporator compartment and a condenser compartment, said condenser compartment having an opening communicating with said room and an opening communicating with the outside, said evaporator compartmet having an opening communicating with the outside and an opening communicating with said room, a refrigerating system including an evaporator in said evaporator compartment and a condenser in said condenser compartment, blower means for normally flowing room air over said condenser, a second blower means for normally flowing outside air over said evaporator, a common motor for operating said first and second blower means, said second blower means having a greater capacity than said first named blower means, means for reversing the direction of rotation of said blower means so as to reverse the normal flow of air through said evaporator compartment and said condenser compartment whereby outside air flows over said condenser and room air flows over said evaporator, and means for introducing outside air into said evaporator compartment when said blower means is operating in reverse.

3. Air conditioning apparatus comprising in combination, a cabinet adapted to be mounted on the window sill of a room, means for dividing said cabinet into a condenser compartment and an evaporator compartment, an evaporator in said evaporator compartment, a condenser in said condenser compartment, a refrigerant compressor within said condenser compartment, refrigerant flow connections between said condenser, evaporator and compressor, said evaporator compartment having one opening in one wall of said cabinet communicating with the air in the room to be conditioned and having another opening in the same wall communicating with the air outside said room, said condenser compartment having an opening in the wall opposite said one wall communicating with the air to be conditioned in said room and having another opening communicating with the air outside of said room, an evaporator fan for circulating air in through one of said evaporator compartment openings and out through the other of said evaporator compartment openings, fan means for circulating air in through one of said condenser compartment openings and out through the other of said condenser compartment openings, and means for reversing the direction of rotation of said air circulating fans.

4. Air conditioning apparatus comprising in combination, a cabinet adapted to be mounted on the window sill of a room, means for dividing said cabinet into a condenser compartment and an evaporator compartment, an evaporator in said evaporator compartment, a condenser in said condenser compartment, a refrigerant compressor within said condenser compartment, refrigerant flow connections between said condenser, evaporator and compressor, said evaporator compartment having one opening communicating with the air in the room to be conditioned and having another opening communicating with the air outside said room, said condenser compartment having an opening communicating with the air to be conditioned in said room and having another opening communicating with the air outside of said room, an evaporator fan for circulating air in through one of said evaporator compartment openings and out through the other of said evaporator compartment openings, fan means for circulating air in through one of said condenser compartment openings and out through the other of said condenser compartment openings, said condenser being substantially coextensive with one of said openings whereby substantially all of the air flowing through said one condenser compartment opening flows in thermal exchange with said condenser, a common operating means for said air circulating fans, and means for reversing the direction of said operating means.

5. Air conditioning apparatus comprising in combination, a cabinet adapted to be mounted on the window sill of a room, means for dividing said cabinet into a condenser compartment and an evaporator compartment, an evaporator in said evaporator compartment, a condenser in said condenser compartment, a refrigerant compressor within said condenser compartment, refrigerant flow connections between said condenser, evaporator and compressor, said evaporator compartment having one opening communicating with the air in the room to be conditioned and having another opening communicating with the air outside said room, said condenser compartment having an opening in one wall of said cabinet communicating with the air to be conditioned in said room and having another opening in said same wall communicating with the air outside of said room, evaporator fan means for circulating air in through one of said evaporator compartment openings and out through another of said evaporator compartment openings, condenser fan means for circulating air in through one of said condenser compartment openings and out through the other of said condenser compartment openings, means for reversing the direction of rotation of both of said fan means, and means for causing more air to enter said room through said

unit than is discharged from said room through said unit.

6. An all fresh air air conditioning unit for a room comprising in combination, a casing, means for dividing said casing into an evaporator compartment and a condenser compartment, said condenser compartment having an opening communicating with said room at all times and an opening communicating with the outside at all times, said evaporator compartment having an opening communicating with the outside at all times and an opening communicating with said room at all times, a refrigerating system including an evaporator in said evaporator compartment and a condenser in said condenser compartment, blower means for normally flowing room air over said condenser to the outside, a second blower means for normally flowing fresh air only over said evaporator and into said room, means for reversing the direction of rotation of both of said blower means, and means for admitting outside air to the evaporator compartment when said blower means are operating in reverse.

7. An air conditioning unit for a room comprising in combination, a casing, means for dividing said casing into an evaporator compartment and a condenser compartment, said condenser compartment having an opening permanently communicating with said room and an opening permanently communicating with the outside, said evaporator compartment having an opening communicating with the outside and an opening communicating with said room, a refrigerating system including an evaporator in said evaporator compartment and a condenser in said condenser compartment, blower means for normally flowing room air over said condenser to the outside, a second blower means for normally flowing fresh air over said evaporator and into said room, means for reversing the direction of rotation of one of said blower means, and means for admitting outside air to the evaporator compartment when said one blower means is operating in reverse.

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