May 20, 1947. A. H. EBERHART 2,420,939

AIR CONDITIONING APPARATUS

Filed Oct. 25, 1944 2 Sheets-Sheet 1

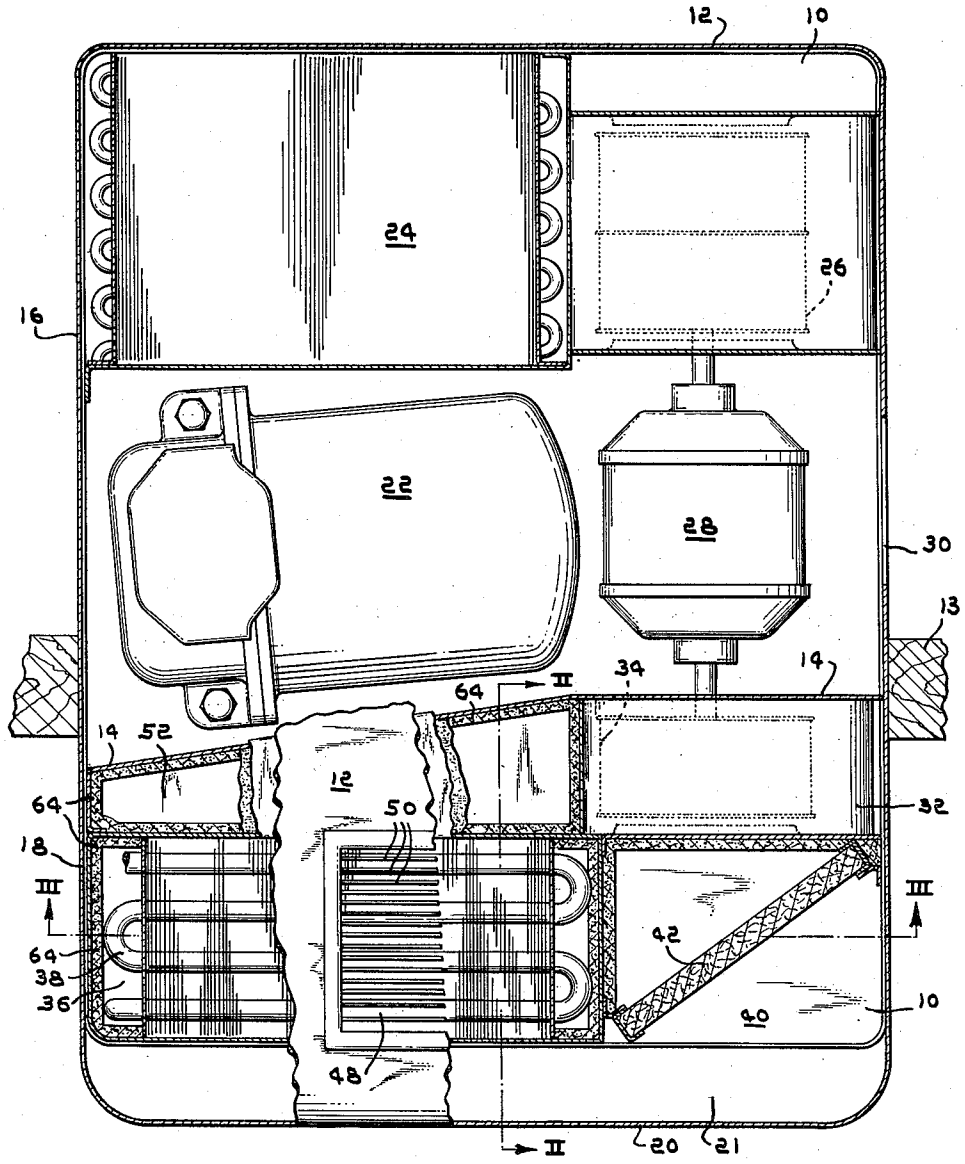


FIG. 1.

WITNESSES:
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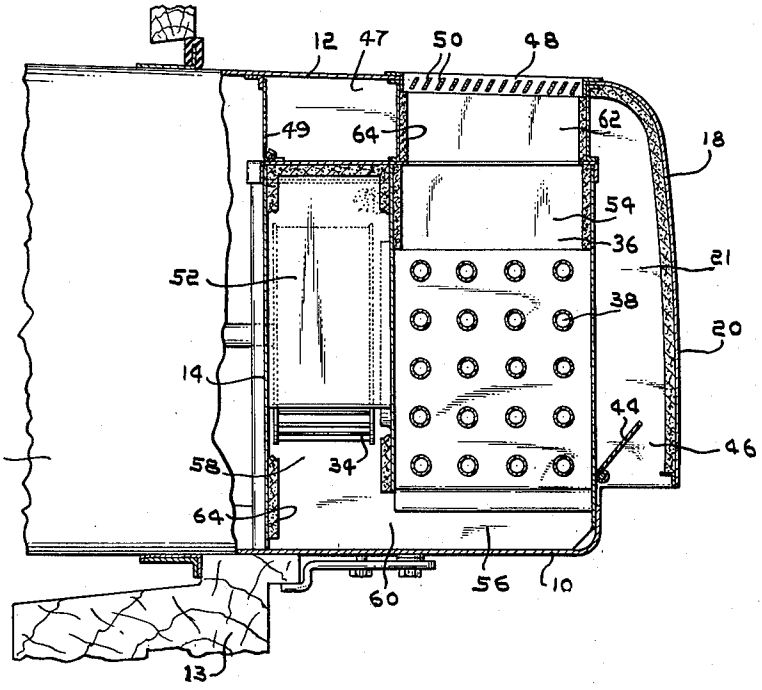
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FIG. 2.



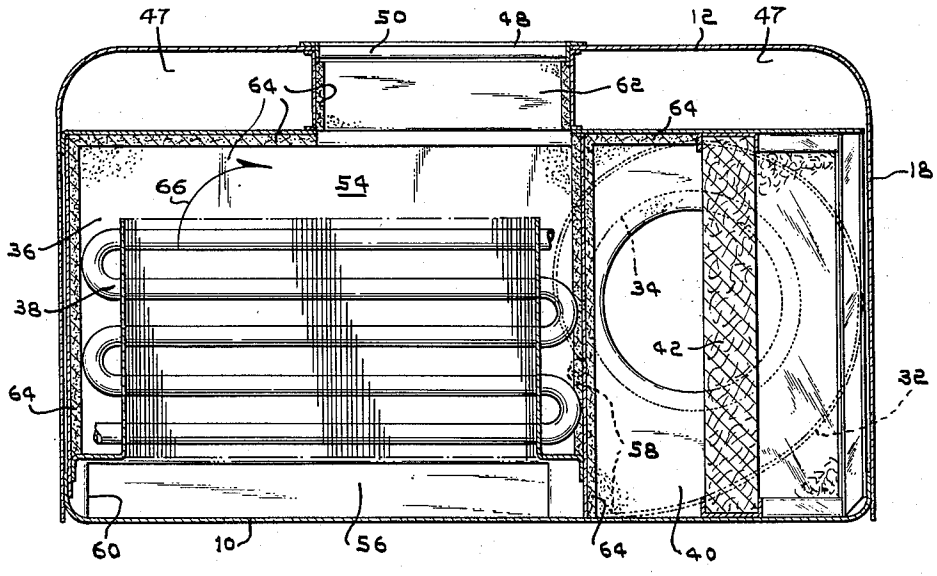


FIG. 3.

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UNITED STATES PATENT OFFICE

2,420,939

AIR CONDITIONING APPARATUS

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Application October 25, 1944, Serial No. 560,265

10 Claims. (Cl. 62—129)

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My invention relates to air conditioning apparatus of the type adapted to be installed and operated in a room or other enclosure.

One object of the invention is to produce an improved apparatus of this type.

A further object is to reduce noise incidental to the operation of apparatus of the type set forth.

A still further object is to accomplish the desired result by a simple and inexpensive structure.

These and other objects are effected by my 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 view, partly in plan and partly in horizontal section, showing an air conditioning unit embodying my invention;

Fig. 2 is a section on line II—II of Fig. 1; and,

Fig. 3 is a section on line III—III of Fig. 1;

In the drawings, I illustrated a room air conditioning unit including a pan 10 and a cover 12 which together form a casing for housing the various parts of the apparatus. The casing is mounted on the bottom sill 13 of a window and is divided by a partition 14 into an outer compartment 16, extending into the outside atmosphere and an inner compartment 18, extending into the room the air of which is to be conditioned. The room end 20 of the cover is spaced from the vertical plane of the room end of the pan 10 to provide a passage 21 later on further referred to. This is best shown in Fig. 2.

The outer compartment 16 houses a motor compressor 22, a condenser 24, a double inlet condenser fan 26 and a motor 28 for driving the condenser fan. The side wall of the outer compartment adjacent the fan is provided with an outside air inlet 30 through which the condenser fan may, in one mode of operation of the apparatus, draw outside air for cooling the condenser. The inlet 30 is controlled by a damper (not shown).

The inner compartment 18 is provided with a compartment 32 which houses an evaporator fan 34, a compartment 36 which houses an evaporator 38, and a compartment 40 which houses a filter 42. The evaporator fan 34 is driven by the motor 28 and is adapted to draw room air through the passage 21 to be conditioned by the evaporator. The passage 21 is provided with a pivoted damper 44 which is movable to a position fully closing the lower end of the passage, or to a position in which the damper cooperates with the front wall 20 of the cover to define a restricted air inlet 46.

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The inlets 46 and 30 are connected by a passage 47 formed on either side of a duct 62 and controlled by a damper 49. The duct 62 will be hereinafter further referred to. By this arrangement, when the passage 47 is closed, and the room air inlet 46 and the outside air inlet 30 are both open, the evaporator fan 34 draws room air through the inlet 46 into contact with the evaporator and discharges the cooled air back into the room through the duct 62 and a condtioned air outlet 48 formed in the top wall of the cover 12 and provided with a grille 50. Simultaneously, the condenser fan 26 draws outside air through the inlet 30, blows it over the condenser to cool the same, and discharges the air into the outside atmosphere through an opening, not shown, formed in the outer end of the unit. When the room air inlet 46 is closed and the outside air inlet 30 and the passage 47 are open, the evaporator fan draws outside air through the inlet 30 and the passage 47 and blows it over the evaporator and into the room through the outlet 48. Simultaneously, the condenser fan draws outside air, also through the inlet 30, and blows it over the condenser and to the outside atmosphere. When the inlet 46 and the passage 47 are open and the outside air inlet 30 is closed, the condenser fan draws room air through the inlet 46 and the passage 47 and blows it over the condenser and to the outside atmosphere. Thus, by the various adjustments described, room air, exclusively, may be reconditioned and recirculated, or it may be exhausted, or outside air, exclusively, may be conditioned and admitted into the room. Obviously, by proper setting of the damper 49 and by adjusting the dampers controlling the inlets 46 and 30 to intermediate positions, room air may be partly circulated and partly exhausted, or a mixture of room air and outside air may be conditioned and admitted into the room. In Fig. 2 of the drawings, the damper is shown in the position which it will occupy when the apparatus is used for conditioning and recirculating room air, if the outside air inlet 30 is open, or for withdrawing air from the room, if the inlet 30 is closed. The manner in which the circulation of air through the unit is effected, and the manner in which the damper 44 is actuated or adjusted form no part of this invention and are, therefore, not shown or described, in detail. For a full explanation of these features reference may be had to my copending application, Serial No. 486,136, filed May 8, 1943, and entitled Improvement in air conditioning apparatus.

The compressor is connected to the condenser

and the evaporator in refrigerant flow relation by suitable pipes, not shown, whereby the evaporated refrigerant is drawn by the compressor from one end of the evaporator and compressed. From the compressor, the compressed refrigerant is delivered to the condenser where it is cooled and liquefied. From the condenser, the liquid refrigerant is delivered, through a suitable expansion device, to the other end of the evaporator to complete the cycle.

In order to improve the operation of an apparatus of the type described, I have provided means for reducing the transmission of fan and other operational noises into the room. For this purpose, the inner compartment **18** is provided with a compartment **52**, which, for the purpose of this application, will be referred to as a silencing compartment. The evaporator is preferably spaced from the top and bottom of the evaporator compartment to provide upper and lower air spaces **54** and **56**, respectively.

The silencing compartment **52** is disposed in alignment with the evaporator fan compartment **32** and communicates with the high pressure side of the fan through an opening **58**, leading from the evaporator fan compartment to the silencing compartment. The silencing compartment is disposed parallel to the evaporator compartment and communicates with the space **56**, below the evaporator, through an opening **60**. The opening **60** is preferably formed by spacing the lower edge of the partition separating the evaporator and fan compartments from the pan **10**. As will be seen from Fig. 2, the direction of flow of air through the opening **60** will be at a right angle to the direction of the flow of air from the evaporator fan compartment into the silencing compartment **52**.

The upper space **54** of the evaporator compartment communicates with the room outlet **48** through a throat **62** so that the flow of air through the throat **62** and outlet **48** is at a right angle to the direction of the flow of air from the silencing compartment to the evaporator compartment through the opening **60**.

The surfaces of the various compartments or passages into which, or through which, air flows are lined with sound-deadening material **64**. The bottom surfaces of the silencing compartment **52** and the evaporator compartment **36**, where condensate may collect, are left unlined.

In order to reduce noise transmission as much as possible, the area of the opening **60** is made as small as possible without unduly reducing the flow of air. For example, in apparatus built substantially as shown in the drawings, I have found that good results can be secured if the opening **60** is about one-seventh of the distance between the top and bottom of the silencing compartment.

Operation

The air moved by the evaporator fan **34** is discharged through the outlet **58** into the silencing compartment **52** in which the velocity and turbulence of the air are reduced and in which sound waves moving with the air stream will impinge upon the sound-deadening lining on the walls of the silencing compartment. The sound-deadening lining will absorb a major portion of the sound waves and such waves as are not immediately absorbed will be reflected back and forth between the walls of the silencing compartment where such sound waves are further progressively destroyed before reaching the opening **60** leading to the space below the evaporator. The change in the direction of flow of the air as it passes from the silencing compartment to the evaporator compartment through the opening **60** further disrupts the air stream, thus tending to break up and neutralize some of the remaining sound waves.

It will thus be seen that, by providing the silencing compartment **52** between the blower and evaporator compartments, the noises originating in the region of the fan compartment will be greatly reduced so that only a relatively small portion of such noises will reach the evaporator compartment. It will also be seen that the provision of the relatively small opening **60** and the change in the direction of the flow of the air, as above pointed out, cooperate in destroying or reducing the transmission of operational noises to the evaporator compartment.

It will be apparent that the addition of the air silencing compartment does not materially increase the cost, size or weight of an air conditioning unit of this type and that it does not materially reduce the flow of air.

From the space **56**, the air flows upwardly between the tubes and fins of the evaporator into the upper space **54** and through the throat **62** and outlet **48** into the room. In flowing through the evaporator, the air is further diffused, thus tending to break up sound waves remaining in the air and such sound waves as remain will impinge upon and, to a great extent, will be absorbed by the sound-deadening lining on the walls of the evaporator compartment and the throat **62**.

In order still further to reduce the transmission of noises to the room through the outlet **48**, I prefer to make the outlet as small as possible without unduly restricting the flow of air therethrough. In a unit built substantially as illustrated, the area of the outlet **48** is preferably about one-half of the area of the space **54**. Therefore, only the sound waves moving with the portion of the air stream which registers with the throat **62** will have access to the throat **62** and the outlet **48**. The sound-deadening lining on the walls of the throat and outlet will, of course, absorb some of the sound waves. The sound waves carried by the remaining portion of the air stream will impinge upon, and will be absorbed or reflected by, the lining on the underside of the top wall of the evaporator compartment. As indicated by the arrow **66** in Fig. 3, the portion of the air stream which impinges upon the underside of the top wall of the evaporator compartment must change its course by about 90 degrees before it can reach the throat **62**. In other words, this portion of the air stream must move horizontally and will impinge upon, and mingle with, the portion of the air stream moving upwardly. This tends further to diffuse the air and break up the sound waves remaining in the air stream approaching the outlet **48**.

In order to reduce noise transmission into the room through the inlet **46**, I also prefer to make the inlet as small as possible without unduly reducing the flow of air therethrough. In the apparatus illustrated, the area of the inlet **46** is preferably about one-fourth of the area of the filter compartment, measured in a vertical plane. By this construction, noise vibrations reaching the passage **21** are either absorbed by the sound-deadening lining on the front cover portion **20**, or they are reflected, back and forth, between the lining on the front cover portion and the filter **42** and the front wall of the evaporator compartment, so that such sound waves are progres-

sively broken up or absorbed. Furthermore, when the damper 44 is in the position shown in Fig. 2, there is a constant stream of air flowing from the room through the inlet 46 so that noise vibrations tending to pass into the room through the inlet 46 must move against the air stream and will, therefore, be further disrupted and destroyed.

While I have shown my 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.

What I claim is:

1. Apparatus for conditioning air in a room or the like, comprising a casing including an evaporator compartment, an evaporator in said compartment, a fan for delivering air to be conditioned to said evaporator compartment, the apparatus having an inlet for admitting air to be conditioned to the intake side of said fan and having an outlet for discharging conditioned air from said evaporator compartment into said room, and a silencing chamber for receiving air from the discharge side of said fan, there being a restricted opening leading from said chamber to said evaporator compartment.

2. The structure recited in claim 1 in which the area of said opening is smaller than the cross-sectional area of said chamber measured in the plane of said opening.

3. The structure recited in claim 1 in which said silencing chamber and said evaporator compartment are so interconnected and disposed that the flow of air from said chamber to said evaporator compartment is substantially at a right angle to the direction of flow of air from the discharge side of said fan into said chamber.

4. The structure recited in claim 1 in which the area of said opening is about one-seventh of the cross-sectional area of said chamber measured in the plane of said opening.

5. The structure recited in claim 1 in which said evaporator is spaced from the bottom of said evaporator compartment to form an air receiving space registering with said opening.

6. The structure recited in claim 1 in which said evaporator is spaced from the top of said evaporator compartment to form an air receiving space, and in which the area of said outlet is less than one-half of the horizontal cross-sectional area of said evaporator compartment.

7. Apparatus for conditioning air in a room or the like including a fan compartment, an evaporator compartment and a silencing chamber disposed in direct air-flow relation with respect to the discharge side of said fan compartment, there being an inlet for admitting air to be conditioned to the intake side of said fan compartment and an outlet for the discharge of said air from said fan compartment to said chamber, an evaporator disposed in said evaporator compartment in spaced relation to the top and bottom thereof to form air receiving spaces above and below said evaporator, and a fan in said fan compartment for delivering the air to be conditioned to said chamber, there being a restricted opening leading from said chamber to the space below said evaporator and another restricted opening leading from the space above said evaporator to said room.

8. The combination with a room-air conditioning apparatus including an evaporator compartment, an evaporator disposed in said compartment in spaced relation to top and bottom thereof to produce air receiving spaces above and below said evaporator, a fan for blowing air to be conditioned over said evaporator, an inlet for admitting the air to be conditioned to the intake side of said fan, and an outlet for discharging conditioned air from said evaporator compartment into said room, of means for reducing noises produced by the movement of air through said fan and said evaporator, comprising an air receiving chamber disposed adjacent one side of said evaporator and into which air is blown directly by said fan, there being a restricted opening disposed parallel to and interconnecting said chamber and the space below said evaporator, whereby the direction of flow of air from said chamber to said space is at substantially a right angle to the direction of its flow from said fan to said chamber, and whereby the movement of air from the space below said evaporator to the space above said evaporator and to said outlet is at substantially a right angle to the direction of flow of air from said chamber to the space below said evaporator, there being a restricted opening leading from the space above said evaporator to said outlet.

9. Apparatus for conditioning air in a room or the like including an evaporator compartment and a filter compartment, an evaporator in said evaporator compartment, a filter in said filter compartment, a fan for drawing air to be conditioned through said filter and discharging it into said evaporator compartment, there being a restricted inlet opening for admitting air to said filter compartment and an outlet for discharging conditioned air from said evaporator compartment into the room, the area of said inlet being less than the cross-sectional area of said filter compartment measured in a plane normal to the flow of air through said filter.

10. The structure disclosed in claim 9 in which the area of said inlet is about one-fourth of the cross-sectional area of said filter compartment measured in a plane normal to the flow of air through said filter.

ARTHUR H. EBERHART.

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