

Feb. 9, 1960

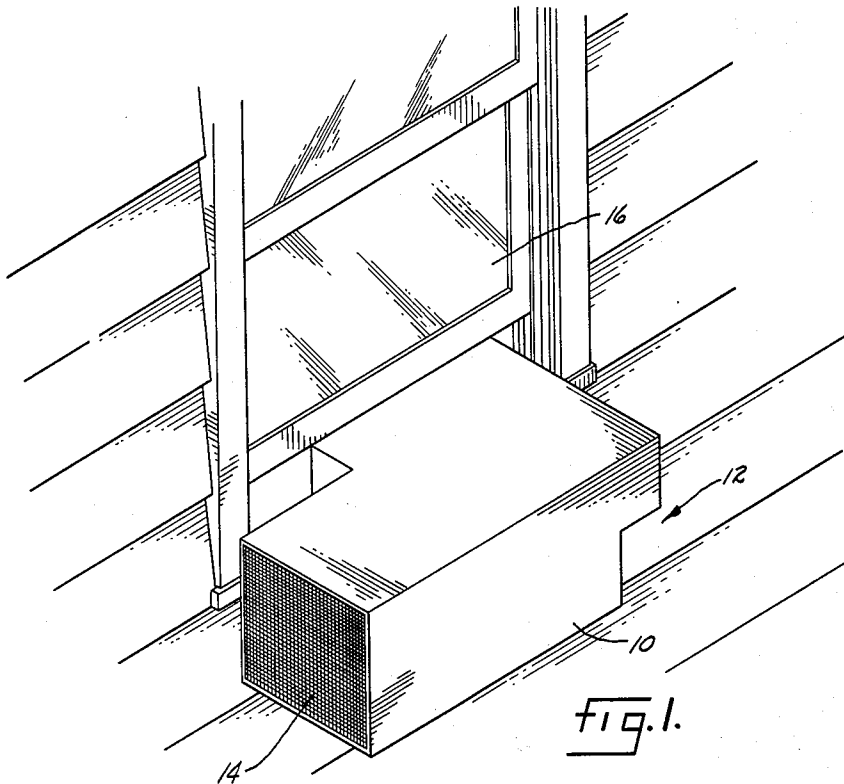
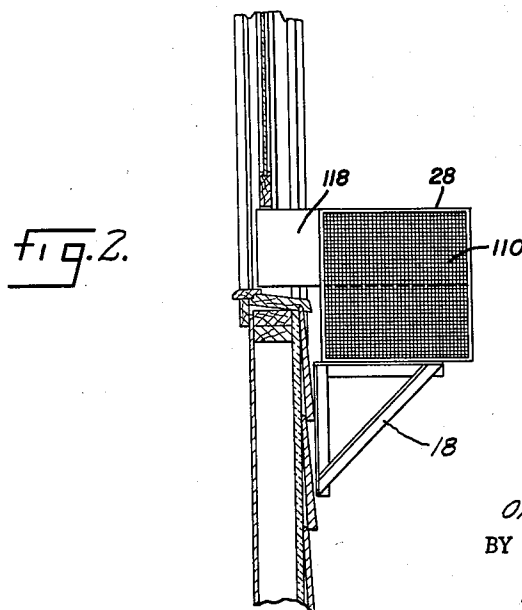
O. P. BULLOCK

2,924,080

ROOM AIR CONDITIONER OR THE LIKE

Filed Feb. 6, 1959

3 Sheets-Sheet 1



INVENTOR.
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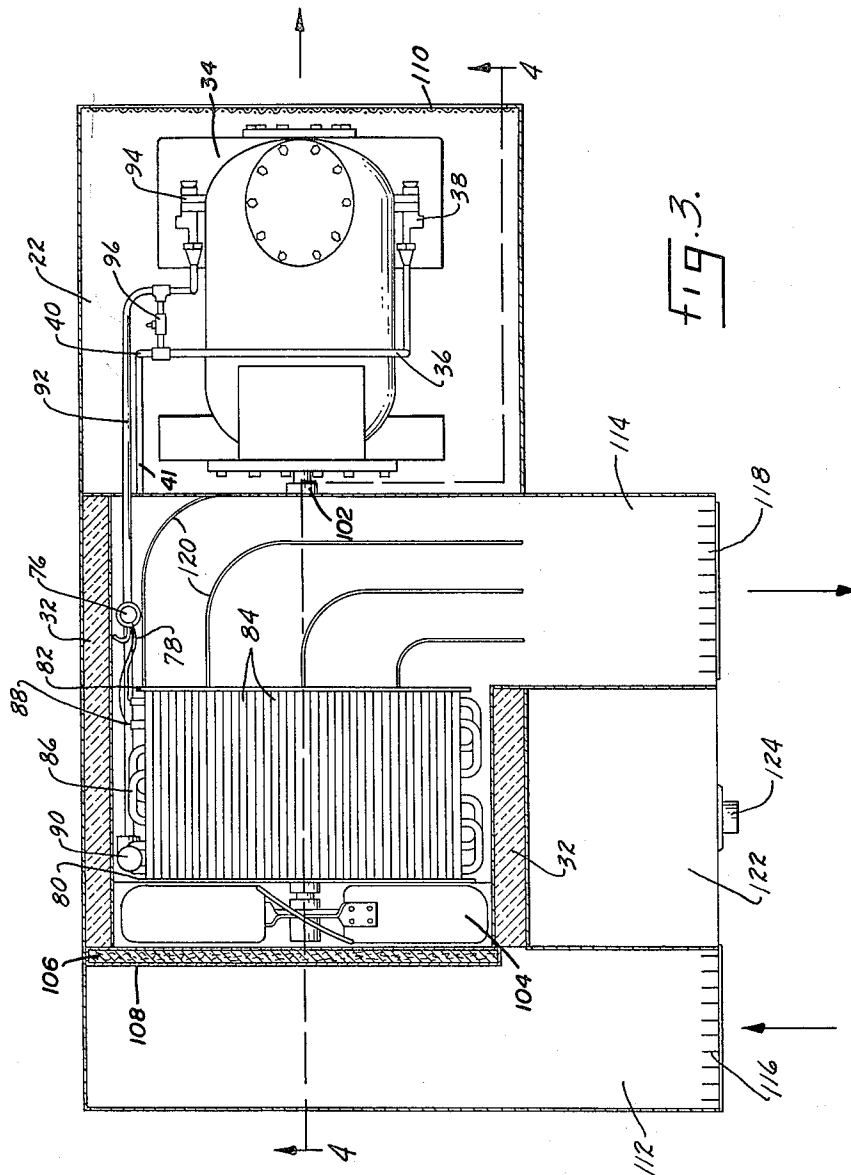
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3 Sheets-Sheet 3

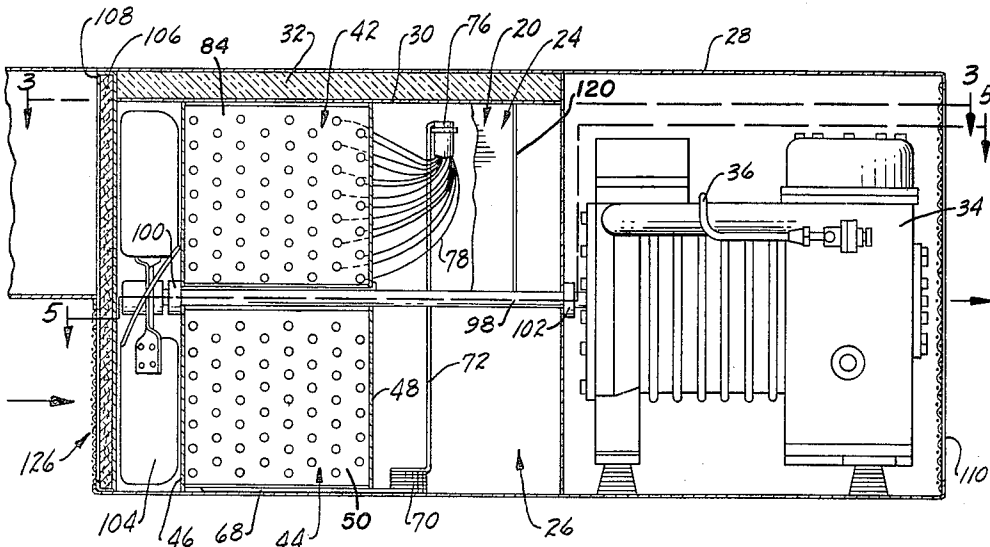


Fig. 4.

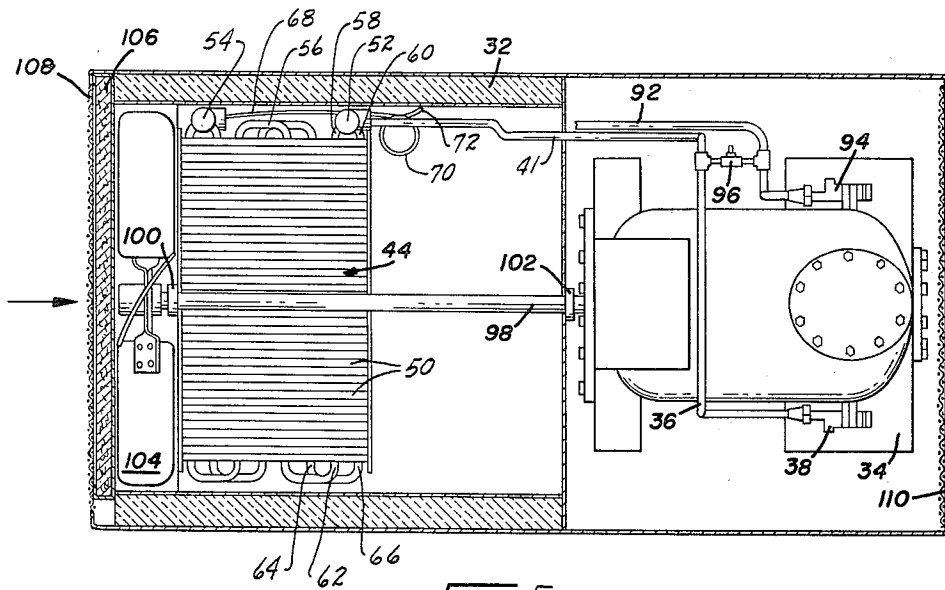


Fig. 5.

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ROOM AIR CONDITIONER OR THE LIKE

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Application February 6, 1959, Serial No. 791,580

10 Claims. (Cl. 62-262)

This invention is concerned with refrigerating or air conditioning equipment and is more specifically intended as a room air conditioning unit of the type intended to be mounted on the window of a room in a dwelling house, but it might be otherwise employed.

A primary object of my invention is a room air conditioner constructed to be attached to the window of a house, for example, which operates efficiently and inexpensively in the hottest weather.

Another object is a room air conditioner of the above type which recirculates air to and from the room to be cooled.

Another object is a room air conditioner of the above type which automatically cools its compressor.

Another object is a conditioner of the above type with an improved evaporator and condenser structure.

Another object is a room air conditioning unit which is inexpensive but efficient.

Another object is a room air conditioner which can be made entirely or almost completely of standard parts.

Another object is a recirculating air feature in a room air conditioner or the like which reduces the heat load on a compressor.

Another object is a housing arrangement for a room air conditioning unit which is simple and inexpensive to fabricate but at the same time provides a novel air flow.

Other objects will appear from time to time in the ensuing specification and drawings in which:

Figure 1 is a perspective of my new and improved room air conditioner mounted on a window;

Figure 2 is a side view of the unit as mounted in Figure 1 with the window and wall shown partly in section;

Figure 3 is a section taken along line 3-3 of Figure 4;

Figure 4 is a section taken along line 4-4 of Figure 3; and

Figure 5 is a section taken along line 5-5 of Figure 4.

In Figure 1 the housing has been indicated generally at 10 with the front end at 12 and the rear end at 14. As shown in Figures 1 and 2 the unit has a somewhat square cross section and is suitably mounted on the side of a house with a portion of the air cooler housing projecting through a window 16 which is unimportant in detail.

As shown in Figure 2 the unit may be mounted on a suitable frame 18 made of angle irons or otherwise, which may be attached by any suitable means to the side of the building. The point is that the particular supporting structure and mounting means is totally unimportant.

The details of the housing and unit are shown in Figures 3 through 5. Generally, the housing is divided into a forward compartment 20 and a rear compartment 22 with the forward compartment divided generally into an upper sub-compartment or chamber 24 and a lower

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sub-compartment or chamber 26. Each end 12 and 14 of the housing is generally open except as otherwise explained hereinbelow.

The housing may be made of an outer metal shell 28. In the forward compartment, an inner shell or wall 30 is provided in spaced relation to the outer shell and the intermediate space may be filled with a suitable insulation 32. Such double shell with insulation in between is shown on top of the forward compartment in Figure 4 and on both sides in Figure 5, and also in Figure 3, for reasons to be set forth hereinbelow.

The housing contains a refrigeration unit which includes a motor driven compressor 34 of any suitable type, the details of which are unimportant. A suitable discharge line 36 is connected to the compressor and is provided with a suitable service valve 38. As shown in Figure 3 line 36 extends across the compressor, turns down at 40 and then extends forward at 41 between the upper and lower subchambers in the forward compartment.

The sub-compartments have a horizontal division and the upper sub-compartment contains an evaporator 42 while a condenser 44 is disposed in the lower sub-compartment. Considering the condenser 44 in detail, for the moment, perforate forward and rear end plates 46 and 48 provide for the passage of air longitudinally therethrough and support a plurality of vertically disposed laterally spaced metallic sheets or plates 50. A generally upright inlet header 52 and a corresponding outlet header 54 are positioned on one side of the condenser, as shown in Figure 5, and a plurality of coils 56 are interconnected between the headers. Each such coil includes a plurality of laterally disposed rectilinear lengths with interconnecting bends, all of the lengths and bends lying in approximately the same plane, the planes of all of the coils being generally parallel. Each such coil provides a tortuous path between the inlet header 52 and the outlet header 54 and all of the coils are connected in parallel and extend through the rib sheets or plates 50. It should be noted that the coils are staggered one above the other. For example, in Figure 5, the topmost coil is connected to the inlet header 52 at the point 58. The second coil is connected to the header 52 at the point 60. The rectilinear length 62 of the topmost coil is spaced approximately midway between the first two rectilinear lengths 64 and 66 of the second coil. Accordingly, as will be noted in Figure 4, a uniformly and symmetrically staggered pattern is provided. The hot gas refrigerant from line 36 will enter the header 52 and be distributed evenly between the vertically spaced coils and will flow back and forth through the lengths and bends to the outlet header 54. In the process the liquid will be cooled substantially due to the passage of air through the condenser and the cooler liquid will be taken from the header 54 by a capillary tube 68 to a capillary coil 70 and then upwardly by a capillary tube 72, shown in Figure 4, to a capillary feeder or distributor 76. The liquid refrigerant is then distributed among a plurality of capillary feeder tubes 78, each of which carries a portion of the refrigerant to a separate tortuous tube in the evaporator.

The evaporator is shown in detail, more or less, in Figures 3 and 4 and includes forward and rear plates 80 and 82 which are perforate to allow for the passage of air. The evaporator includes a plurality of vertically disposed, somewhat equally spaced, upright metal sheets or fins 84. A plurality of tortuous tubes 86 are each connected at one end to one of the capillary feeders 78. For example, for the topmost tube, the connection is made at 88. These tubes are also composed of a plurality of rectilinear, generally parallel lengths extend-

ing laterally across the housing interconnected by preferably integral bends and each such tube is coplanar in a generally horizontal plane. The planes of the tubes are generally equally spaced vertically and parallel to one another. Also, the staggered relationship, as set forth in Figure 5 with relation to the condenser tubes, is also carried out in the evaporator, and the outlet end of all of the evaporator tubes is connected to an outlet header 90 which is disposed somewhat vertically, as shown in Figure 3.

The expanded gas is returned by a suction line 92 to the compressor and a service valve 94 may be provided in the return or suction line. I may also use a conventional relief valve unloader 96 connected across the liquid and suction lines in the event of overload.

A shaft 98 mounted on suitable forward and rear bearings 100 and 102, held by suitable spiders or the like, carries a fan 104 at its forward end, which occupies approximately the entire forward end of the housing. Since the fan is round in outline and the housing is square, the corners should be blocked in or filled so that eddy currents or recirculation of air will be prevented and all of the air moved by the fan will pass through the evaporator and condenser.

The forward end of the housing is provided with a filter 106 carried in a frame 108 and the rear end of the housing, which is otherwise open, has a suitable screen as at 110.

I provide forward and rear side or lateral ducts 112 and 114, respectively, each of which is disposed approximately at 90° to the longitudinal axis of the housing. The forward duct extends across the upper half, generally, of the otherwise open front end of the housing and is generally aligned with the evaporator, as shown in Figure 4. The duct is otherwise closed on all sides except that it has an inlet 116 and is also open to the filter so that air may be drawn through the duct by the fan and directed across the evaporator. The rear duct 114 is on the same level as the forward duct and is only in communication with the evaporator. Thus, the air, as blown across and cooled by the evaporator, is discharged into the duct 114, which has a suitable outlet 118. I find it advantageous to position turning vanes 120 in the outlet duct to direct the air in a smooth non-turbulent turning motion into the outlet duct. It should be noted in Figure 3 that the ends of the forward and rear ducts 112 and 114 extend beyond the side of the housing and the space 122 between them may constitute a control chamber. This is to say that this space 122 may be enclosed and contain the controls for the entire unit. For example, I may have a control knob 124 on the side surface of this chamber. It should be understood that the ducts 112 and 114 in combination with the chamber 122 form a somewhat unitary side extension, as shown in Figure 1, which may project through the partially open window when the conditioner is mounted as shown in Figure 2. In such a mounting, the control 124 will be disposed in the room and the occupant may easily control the unit.

The use, operation and function of my invention are as follows:

I provide an easily controlled room air conditioning unit which is easy to manufacture, composed primarily of standard parts, but at the same time is reliable in operation.

One of the important points of the invention is that the air circulated over the evaporator is first drawn from the room or compartment to be cooled and, after passing over the evaporator, returned to such compartment or room. For example, the duct 112 is an inlet duct returning air from the room or compartment to the unit. The fan forces this air over the evaporator into the outlet duct where it is turned by the vanes 120 and redirected back into the room or compartment through the outlet 118. Cooling air for the condenser is drawn

in through the lower portion of the front end of the housing, which may be covered by a screen, designated 126 in Figure 4. This air flows across the condenser and is discharged onto the compressor and motor drive, then exhausted through the rear screen 110 on the rear end of the compartment. An important point is that the same fan that forces or circulates the compartment air across the evaporator also forces the cooling air across the condenser. It is also important to note that outside air is used to cool the condenser and this same air flows across the motor and compressor to cool it.

The particular structure of the condenser and evaporator is important. In essence, I provide a plurality of tortuously bent tubes, each such tube including a plurality of rectilinear, laterally disposed lengths interconnected by preferably integral bends. Each such tube has its plane disposed generally horizontally and the planes of all of the tubes are approximately parallel and uniformly spaced. The tubes are staggered with relation to those either above or below so that a uniform pattern is presented in side section. I find it advantageous to position a plurality of equally spaced vertically disposed sheets or heat transfer elements across the tubes and they may be connected to the tubes by brazing or otherwise. The point is that these sheets do not interfere with air flow in any way but greatly increase the heat transfer. I find it desirable to connect all the tubes to the refrigerant line in parallel. This is true for both the condenser and the evaporator.

Insulation is only necessary for the evaporator chamber and it should be noted that the insulation 32 extends across the top and down both sides, but there is no insulation on the bottom. Accordingly, while the evaporator is well protected or shielded, the condenser only has insulation on the sides and even this might be eliminated.

While I have shown and described the preferred form and suggested various alternatives, it should be understood that suitable modifications, changes, substitutions and alterations may be made without departing from the invention's fundamental theme. For example, I find it convenient to drive the fan with the same motor that operates the compressor. The unloader 96 is by no means essential, but I find it advantageous. The particular fan used, in detail, is not important, but I do find it advantageous to use this same fan for forcing air across both the condenser and the evaporator. At the same time, the fan forces air through the condenser space across the motor and compressor to cool it. With these and other modifications in mind, I, therefore, wish that my invention be unrestricted except as by the appended claims.

I claim:

1. In an air conditioning unit for use as a room conditioner by attachment to a window, a housing generally open at both ends to provide for the flow of air through it, a refrigerating unit in the housing including a compressor, a condenser connected to the compressor, expansion means connected to the condenser, an evaporator connected to the expansion means and positioned beside the condenser, a return line from the evaporator to the compressor, a fan disposed in one end of the housing ahead of the evaporator and condenser so as to discharge air to both of them, and forward and rear side ducts on the housing, one disposed ahead of the fan and the other behind the evaporator and each being adapted to project through the window of the room to be cooled, the forward duct being a return air duct for returning air from the room to the evaporator to be cooled, the rear duct being a supply air duct for supplying cooled air from the evaporator to the room.

2. The structure of claim 1 further characterized in that the forward side duct covers approximately one-half of the front end of the housing and fan, the other half being open and in communication with the condenser and compressor.

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3. The structure of claim 1 further characterized in that the evaporator is positioned above the condenser.

4. In an air conditioning unit, an elongated housing generally open for the flow of air therethrough, a refrigerating unit in the housing including a compressor, condenser and evaporator elements disposed side by side in the housing, one above the other, an expansion device between the condenser and evaporator, both the condenser and evaporator each including a plurality of separate vertically spaced bent coils, each such coil including a plurality of rectilinear, coplanar, laterally disposed lengths interconnected by integral bends, the lengths of one coil being staggered and disposed somewhat equidistant between the lengths of its adjacent coils, at least one end of the coils being connected to a header, a return line from the evaporator to the compressor, the housing being generally open at both ends to provide for the flow of air through it, and a fan disposed at the forward end of the housing ahead of the condenser and evaporator to force air over both of them.

5. The structure of claim 4 further characterized in that the lengths of each coil are generally parallel.

6. The structure of claim 4 further characterized by and including a plurality of generally parallel, upright, equally spaced, longitudinally disposed metal sheets in both the evaporator and condenser in heat transfer relation with the coils.

7. The structure of claim 4 further characterized by and including forward and rear lateral ducts on the housing, the forward duct being disposed ahead of the fan and on the same level with the evaporator closing one portion of the otherwise open front end of the housing, the rear duct being disposed behind and closing the rear end of the evaporator so that substantially all air flowing through the evaporator from the fan will be discharged through the rear duct.

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8. The structure of claim 4 in which the evaporator is positioned above the condenser.

9. In an air conditioning unit for use as a room conditioner by attachment to a window frame, a housing generally open at both ends to provide for the flow of air therethrough, a refrigerating unit in the housing including a compressor, a condenser, and an evaporator, the evaporator and condenser being disposed laterally next to each other in side-by-side relation across the housing, a fan disposed in the forward end of the housing ahead of the evaporator and condenser and constructed, upon rotation, to discharge air to both of them, forward and rear side ducts on the housing, one disposed ahead of the fan and the other behind the evaporator and each being adapted to project laterally from the housing through the window of the room to be cooled, both ducts covering only the portion of the housing longitudinally opposite the evaporator, the other portion longitudinally opposite the condenser being open, the fan being disposed to cover both portions of the housing and serving to draw air through the open end of the housing and force it across the condenser and at the same time to draw air from the room through the forward side duct, force it through the evaporator and return it to the room through the rear side duct.

10. The structure of claim 9 further characterized in that the evaporator is disposed above the condenser, each filling approximately one-half of the housing.

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