US PATENTS
FULL PATENT EXAMPLE

USP 2,316,704 April 13, 1943
P B MOORE AIR CONDITIONER

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AIR CONDITIONER

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Fig. 3

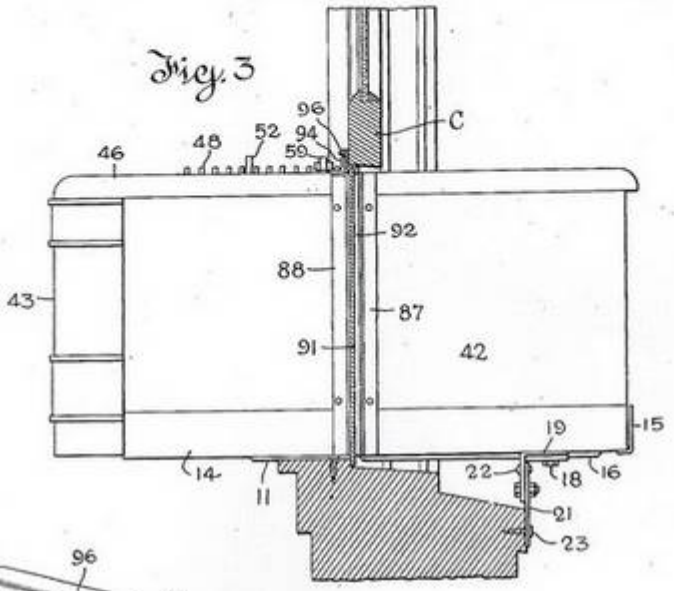

Fig. 4

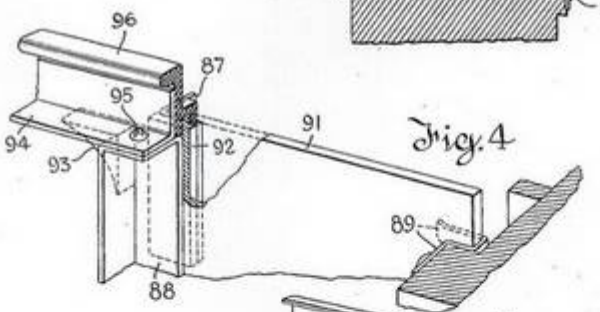

Fig. 5

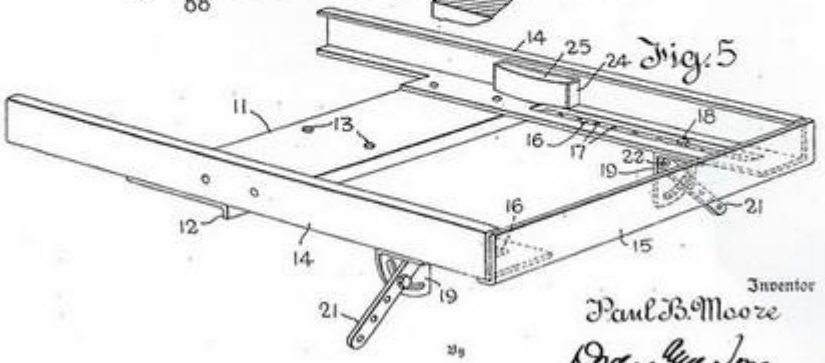

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Fig. 6

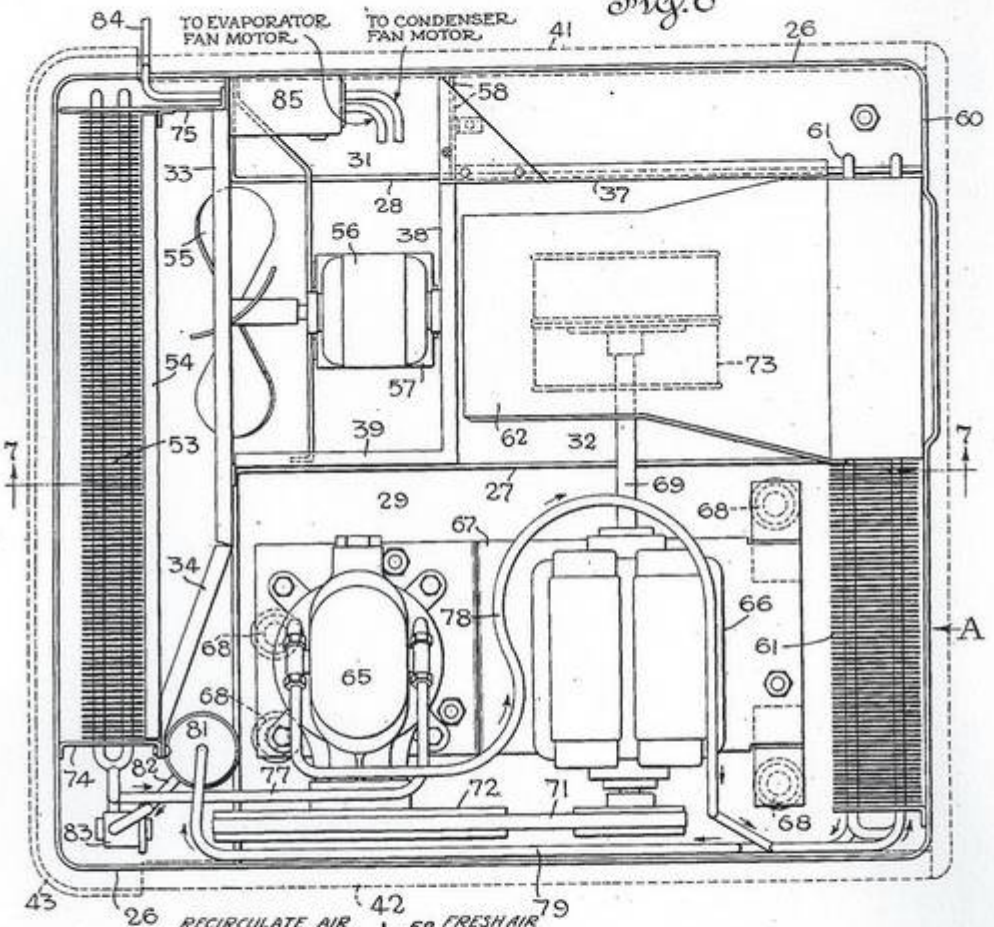
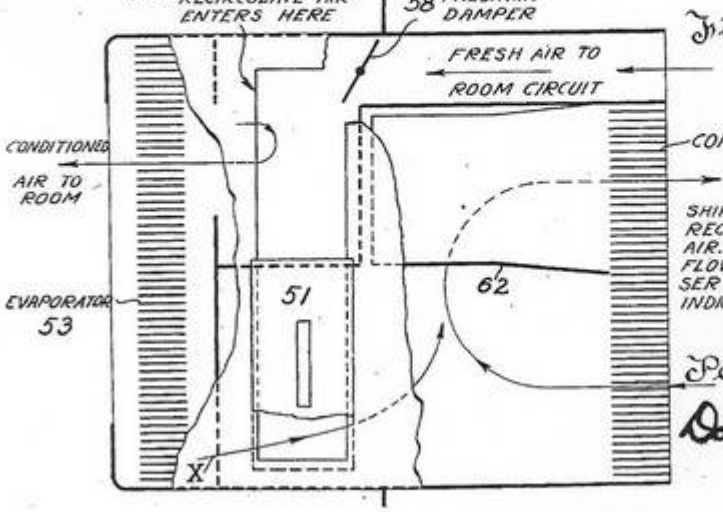


Fig. 9



SHIFTING DAMPER 51 STOPS RECIRCULATION OF ROOM AIR. ROOM AIR THEN FLOWS BY WAY OF CONDENSER FAN TO OUTSIDE AS INDICATED BY ARROW X.

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Fig. 7

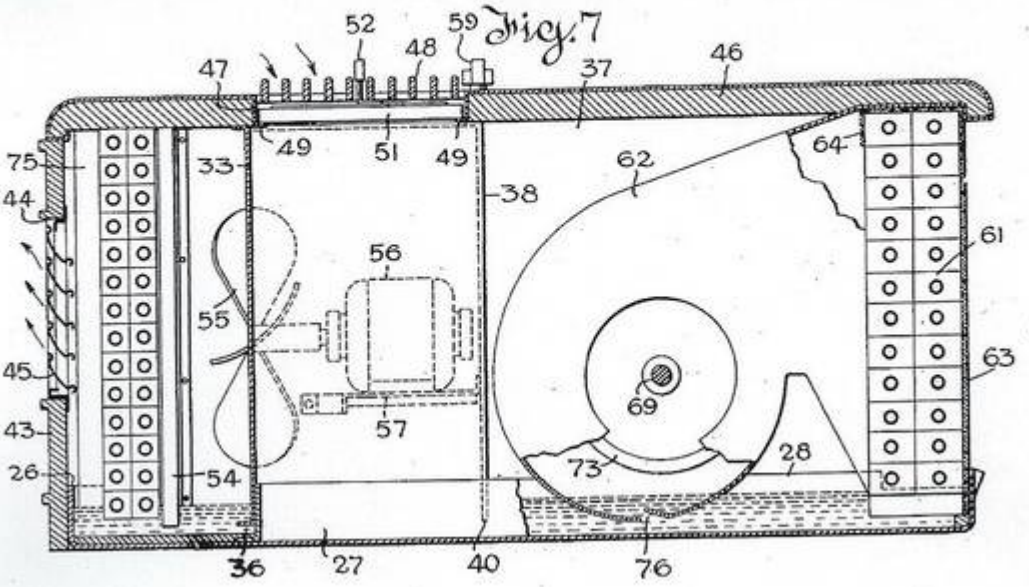
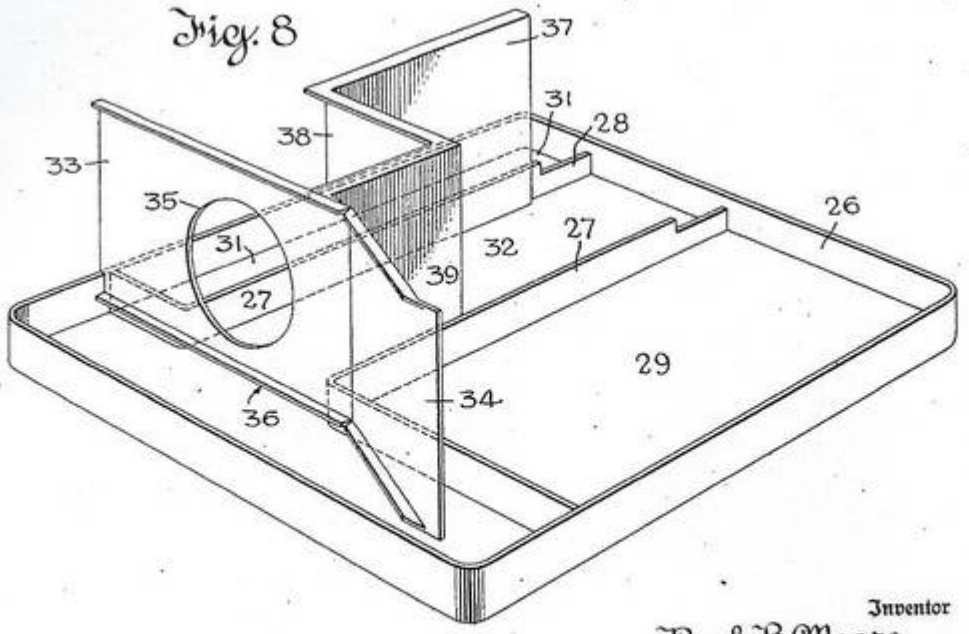


Fig. 8



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UNITED STATES PATENT OFFICE

2,316,704

AIR CONDITIONER

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Application August 2, 1940, Serial No. 349,828

8 Claims. (Cl. 62—129)

This invention relates to air conditioners of the refrigerative type and provides a compact unit capable of being mounted on a window sill beneath a raised sash with the condenser air circuit almost completely external to the room and the room air circuit wholly within the room.

The commercial embodiment of the invention has a mechanical output of approximately one-half horse power and a refrigerating rating of about one-half ton, from which it may be understood that the unit is one of substantial capacity, so that the invention offers a unit of the window sill mounted type adequate to condition a room whose floor area is of the order of 275 sq ft.

The solution of the problem of enclosing a unit of this capacity within the dimensional limits implied by this class of service requires very careful design and arrangement of parts. Thus while the refrigerative circuit is conventional, and the basic components of the conditioning system are known, the novel structure and arrangement hereinafter described in detail represent a substantial advance in this particular field.

The unit combines in a very simple structure a condenser air circuit in which the air enters in heat exchanging contact with part of the condenser (at least a part of such air flowing also over the compressor) and after contact with sprayed drip water is discharged in cooling contact with the remainder of the condenser. The motor which drives the compressor also drives the fan for the condenser air circuit. This fan is used to spray the drip water condensed from the room air circuit by the evaporator. The base pan for the machine is so contrived as to collect this drip water and deliver it to the condenser fan, the water maintaining a seal between the two air circuits in the machine and being so confined that it is kept out of the compartment in which the compressor and its motor are mounted.

The construction provides a fresh air inlet to the room air circuit, together with a damper controlling the in-flow of fresh air. Readily accessible means are provided for operating such damper, the damper adjusting means being mounted on top of the unit where it may easily be seen and reached.

The device also includes a so-called pump-out port permitting room air to be admitted to the condenser fan intake when it is desired to free a room from smoke or to change the air therein for any reason. This pump-out opening and the return air inlet for the room air circuit are opened selectively by a single damper so that when the pump-out passage is opened, the return air inlet from the room is closed. By opening the pump-out circuit, and at the same time opening the damper in the fresh air inlet, a very effective ventilating circuit is afforded with results superior to those secured with any prior art arrangement for a similar purpose so far as applicant is advised.

A feature of the invention is the provision of a separate fixed mount which is supported directly on the window sill and which includes adjustable stays designed to secure the utmost rigidity. This support is the sole sustaining means for the unit, permits the unit to be placed in position safely and permits the window sash to be raised and lowered while the unit is in place. This last is an important feature in those cases where the unit is mounted in a room having only one window.

The preferred embodiment will now be described in connection with the accompanying drawings, in which:

Figure 1 is an elevation of the unit mounted on a window sill beneath the sash and viewed from within the room.

Fig. 2 is a plan view of the unit shown in Fig. 1, portions of the window frame being indicated in section.

Fig. 3 is a section on line 3—3 of Fig. 2.

Fig. 4 is a perspective view showing how the fill pieces are mounted at the sides of the unit to close the intervals between it and the window frame.

Fig. 5 is a perspective view of the frame which is mounted on the window sill to receive the unit. In this view the frame is shown detached and viewed from its outer (outdoor) end.

Fig. 6 is a plan view of the unit with the cover removed. This view shows the relative positions of the components of the refrigerating circuit and the positions of the various partitions which direct the air flows.

Fig. 7 is a section on the line 7—7 of Fig. 6.

Fig. 8 is a perspective view of the base pan with the partitions in place and the components of the refrigerating circuit removed as also are the fans.

Fig. 9 is a diagrammatic plan view of the device with the mechanical components omitted and with the air paths indicated by arrows and legends.

The supporting framework which is mounted on the window sill comprises a plate 11 with a downwardly extending flange 12 which rests on the window sill, the flange engaging the outer

face of the sill in the plane of the inner side of the lower sash. This plate is connected to the sill by screws passed through the holes 13. Fixed to the plate 11 and at right angles thereto are two channel side frames 14 which are connected at their outer end by a strip of angle iron 15. Portions of the lower flange of the channel members 14 are offset downwardly, as indicated at 16, and are provided with a series of holes 17. The offsets provide space for the heads of bolts 18 which pass through the holes 17 and connect clips 19. Carried by these clips are strut braces 21 which are adjustable about pivots 22 and which are fastened to the outer sill by any suitable means indicated by the lag screw 23. At any rate the framework above described is supported for its full width on the inner sill and is supported at two points on the outer sill so that a rigid structure is afforded.

Mounted in the channel side members are clips 24 which house slightly convex sponge rubber pads 25 designed to seal with the base or pan portion of the case of the unit hereinafter described, the purpose being to prevent air leakage between each channel 14 and the base of the insertable unit.

The unit is carried on a base pan having a marginal upstanding flange indicated at 26 (see Fig. 8). Thus the base serves also as a water-tight pan. There are two L-shaped divider partitions 27 and 28 whose height approximates the height of the marginal flange 26 of the base pan, the partitions being welded or otherwise connected water-tight with the bottom of the pan. They thus sub-divide the pan into three isolated spaces: the space 29 in which the main machinery base is mounted; the space 31 which is beneath the fresh air inlet duct; and a T-shaped water space 32 which at its head or forward end underlies the evaporator, the stem of the T extending rearward beneath the condenser fan hereinafter described, and between the spaces 29 and 31.

Extending generally across the rear of the evaporator space and welded to the forward portion of the dividers 27 and 28 is the vertical partition 33 which has an angularly offset portion 34 and a fan port 35. This partition 33 is the full height of the interior of the unit except that it is spaced above the bottom of the pan, leaving at 36 a water slot or passage so that drip from the evaporator in the head of the T-shaped passage 32 can pass under the partition 33 into the stem portion of the T-shaped passage 32.

There is a zigzag partition comprising a portion 37 which forms a vertical continuation of a portion of divider 28 and is in effect an upward extension thereof, an offset portion 38 which affords a fan motor chamber communicating with the fresh air duct, and a portion 39 which extends from the portion 38 forward and is welded to the partition 33 and also to part of the L-shaped divider 27 already described. The relationship of the various partitions can be traced on Fig. 6. The lower margin of offset portion 38 is above the bottom of the pan to afford a passage for drip water (see 40 in Fig. 7).

The housing of which the pan forms the base is enclosed by side members 41 and 42 and a front member 43, the latter being removably mounted and being provided with an air discharge port 44 with adjustable louvers 45. These louvers are individually pivoted in the frame which surrounds the port 44 and are connected so that they may be adjusted in unison, the connecting means being conventional and not shown in the drawings (see Fig. 7).

The side members 41, 42 and 43 are carried by the flange 26 forming the base pan. It is important to observe that as indicated in dotted lines in Fig. 6 the side members 41 and 42 are offset outwardly from the top of the marginal flange 26 of the pan. The height of the pan very slightly exceeds the height of the channel side frames 14 and the offset is coextensive with the width of the channel side frames 14. Thus there are rabbets which receive and house the side frames 14. This explains the fact that when the device is viewed in plan (see Fig. 2) the channel side frames are not visible. The side members are preferably made of sheet metal lined with sound deadening and heat insulating material according to principles familiar to those skilled in the art. The top of the unit is closed by a cover 46 which is removable and which also is formed of sheet metal lined with sound deadening and heat resisting material. The back of the case is open and is spanned by the condenser hereinafter described, except for a small opening coextensive with the fresh air inlet.

Extending substantially the entire width of the cover 46 is a rectangular opening 47 with a grille 48. Slidable in ways 49 beneath the grille 48 is a damper 51, whose length is slightly more than half the length of the opening 47. The damper may be shifted from end to end of the opening by handle 52 which extends upward between elements of the grille 48. This damper selectively opens a return air passage from the room to the evaporator air circuit or from the room to the condenser air circuit, the latter communication being an abnormal setting used when it is desired to utilize the large capacity air fan to draw smoke or foul air from the room.

The evaporator air circuit will now be described. There is a finned multipass coil conventionally illustrated at 53. It is forward of the partition 33, 34 and slightly to the rear of the louvers 45. Behind it a filter 54 is removably mounted in guides so that it may be drawn out at the top after removal of the cover 46. This filter is preferably of the spun glass low flow resistance type and offers an area coextensive with the area of the evaporator.

The air circulating fan is indicated at 55 and is mounted in the port 35. The fan is supported on the shaft of an electric motor 56 which is mounted on a bracket 57 (see Fig. 7) located to the rear of the partition 34 and forward of the offset 38. Fresh air enters at 60 and flows through the fresh air duct under the control of a damper 58. This is fixed on a vertical shaft projecting through the cover 46 and carrying a handle 59 (see Figs. 1, 2 and 7) by which the damper may be turned to control the amount of fresh air flowing to the fan 55.

Under normal operating conditions the return air damper 51 is to the right, as viewed in Fig. 2, so that the major portion of the air flowing to the fan 55 enters through the grille 48 from the room. (See Fig. 9.) Fresh air, up to about 25% of the total, may be drawn in if damper 58 is opened. All the air propelled by the fan 55 flows first through filter 54 and then in contact with the coils and fins of the evaporator 53, after which it is discharged through louvers 45 into the room. These louvers can be adjusted to deflect the stream of air upward or outward as desired.

The condenser air circuit will now be described.

The condenser is a finned multipass tubular coil generally indicated at 61 and extending across the entire open rear end of the housing except for the interval 60 forming the fresh air opening. Mounted within the stem portion of the T-shaped compartment 32, and behind the offset 38 is the snail shell housing 62 of the condenser air fan. This housing is arranged to discharge through the left half of the condenser 61 (see Figs. 6 and 9). This half of the condenser is sheathed on the outer side with fine mesh wire screen cloth 63 which extends over the top of the condenser 61 and downward on the inner side for a short distance, as indicated at 64 in Fig. 7.

The condenser air fan atomizes water and the function of the screen 63 is to keep droplets of water from being blown out with the condenser air stream. The water is arrested by the screen. Most of it is evaporated but any excess will run back to the water pan and be again sprayed by the fan.

The compressor generally indicated at 65 and the electric motor generally indicated at 66 are fixedly mounted on a base 67. This base is mounted on four coil springs 68, two at the outer and two at the inner end (see Fig. 6). These springs serve the familiar purpose of allowing the motor and compressor to vibrate slightly within the housing so that the vibration is not transmitted to the housing and noise is eliminated.

The motor 66 has a shaft 69 which at one end carries a pulley connected by a V-belt 71 with the grooved fly wheel 72 of the compressor 65. The other end of shaft 69 extends through the intake port of fan housing 62 and within that housing carries the squirrel cage fan rotor 73.

The evaporator has two end plates 74 and 75 which complete the segregation of the evaporator or room circuit air path and the condenser or outside air path by closing gaps between the front 43 of the housing and partitions 33 and 34.

The condenser air enters through the right hand half of the condenser 63, as indicated by the arrow A on Fig. 6, flows over the motor 66, some of it flowing in contact with the compressor 65. All of such air enters the eyes of fan housing 62 to reach the rotor 73 of the condenser fan. This fan discharges through the left hand portion of condenser 61. The condenser air path is clearly indicated on Fig. 9.

Housing 62 has at its bottom a slot 76 through which drip water from the evaporator 53 enters. Such drip collects in the T-shaped portion 32 of the base pan. Since the fan rotor runs at high speed, a portion of this water is entrained by the fast flowing air and sprayed. Some of this water is evaporated in suspension in the air, and some is thrown against the fins of the condenser 61. In either case the effect is to evaporate the drip in the condenser air stream. This idea of re-evaporating drip is not broadly new but the arrangement above described offers a very simple scheme for delivering the water from the evaporator to the fan without requiring the evaporator to be elevated and without danger that water will enter the machinery compartment in which the motor and compressor are mounted.

The refrigeration circuit connections will now be traced. The suction line from the evaporator to the compressor is indicated at 77 and the high pressure discharge line at 78. These are looped to permit vibration of the compressor. High pressure line 78 discharges into the condenser 57, from which the liquid line 79 leads to receiver 81. From the receiver liquid refrigerant passes by connection 82 to the automatic expansion valve 83 of conventional form. This expansion valve feeds the evaporator.

Electric current for the fan motor 56 and for the main compressor motor 66 is supplied by a cable 84 which may be plugged into any electrical outlet. The motor control switch 85 is operated by the knob 86 and may be set to run the fan motor 56 alone or to run both motors 56 and 66 simultaneously, or to stop both. The electrical connections from the switch 85 to the two motors are indicated by legend at the top of Fig. 6 and are only partly shown since they are conventional.

The unit as above described and with the cover 46 in place is slid outward between the guiding portions of the channel members 14, the unit being sustained by the lower horizontal flanges of the channel, which are wider than the upper flanges, and the channel members 14 entering the rabbets described as extending along the lower margins of the side walls 41 and 42 respectively. The sponge rubber blocks 25 produce air seals within the channel.

Since the unit is narrower than the ordinary window sill, means must be provided to close the interval between the sides of the unit and the sides of the window opening substantially in the plane of the inner face of the lower sash. To accomplish this result, a pair of angle irons 87 and 88 are attached to each side 41 and 42 of the unit in such position that when the unit is pushed out as far as it will go, that is until it strikes the flange of the angle iron 15, the outer face of the inner angle iron 88 will be in plane with the outer (flanged) face of the frame member 12. The lower ends of the angle irons 87 and 88 overlap the outer faces of the channel side frames 14 since they extend to the bottom of the base pan 26. This overlap is clearly shown in Fig. 3.

The clip shown at 89 in Fig. 4 is screwed to the inner guide of the lower sash, after which a filler piece 91 of insulating board is cut to proper size and slid into the channels afforded by the angle members 87 and 88 and the clip 89. A sponge rubber gasket 92 is inserted between the filler piece and the angle 87 and an arcuate block 93 of sponge rubber which fits the fillet along the edge of top 46 prevents leakage at this point (see Fig. 4).

After the unit is in place a removable angle strip 94 is mounted by screw 95 at each end, such screws engaging a seat formed in the upper end of the angle 88 (see Fig. 4). Then an h-shaped rubber sealing strip 96 is mounted as indicated in Fig. 4. The filler pieces 91 extend upward above the top 46 of the case, and are slightly to the rear of the rear face of angle strip 94. The rubber strip straddles the top edges of the filler pieces 91, and where it passes over top 46 seats on such top and against the rear face of angle strip 94. The sash C, when lowered, seals as best indicated in Fig. 3. It has no case-sustaining function and may be raised at any time.

In considering the air flows as described in the next three paragraphs, reference should be made to Fig. 9.

When both motors 56 and 66 are operating, the fan 55 circulates air through the filter and the evaporator to the room. This air is drawn in the main from the room, but if the damper 58 be open more or less, a desired proportion of fresh air may be drawn from out of doors. The maximum proportion of fresh air delivered to the room is

about 25% of the total air circulated by the fan 55.

Condenser cooling air is drawn from out of doors, through the right hand half of the condenser, is then sprayed with the cold drip water, and thereafter is discharged through the left hand half of the condenser 61.

If it is desired to change the air in the room rapidly, the damper 51 is shifted to the left, in which event the large port is opened from the room directly to the intake of the fan housing 62 so that the condenser fan draws air from the room and discharges it out of doors. At this time the flow of air from the room to the fan 55 is cut off, and ventilation can then be assisted by opening the damper 58 wide so that fan 55 delivers outdoor air to the room at the same time that fan 73 is drawing air from the room and discharging it out of doors.

Arrangement of the machine elements of the conditioner is believed to be quite important from the standpoint of balance and compactness. The compressor and the motor are mounted in a line from front to back in the machine. Adjacent these two and also arranged in a line from front to back of the machine are the room circuit fan with its motor and the snail shell of the condenser air fan, the runner of the condenser air fan being mounted on the compressor motor. The space required for these parts produces a very nice rectangular plan for the machine. The fresh air duct then must run along one of the other sides of the unit and the arrangement shown is believed to be the simplest. The mounting of the room circuit motor and fan in an offset permits this to be aligned transversely with the compressor, an arrangement which makes it possible to use the single damper 51 to control the flow of air from the room alternatively to the room circuit fan or to the condenser air circuit.

The features above outlined are subject to considerable modification within the broad scope of the invention. Basically the problem is one of compact arrangement, accessibility, ease and safety of mounting, and similar features, rather than the basic refrigerating circuit or air conditioning circuit, each of which is known in its broader aspects.

I claim:

1. The combination of a unit air conditioner having means defining two air circuits, a room air circuit having a main inlet from the room whose air is to be conditioned, a secondary inlet of limited capacity leading from a space external to the room and a discharge into said room, and a condenser air circuit having an inlet and a discharge both connected with space external to said room; a room circuit fan for circulating air in the room air circuit; a damper operable to throttle variably the secondary inlet to the room air circuit; a condenser circuit fan for circulating air in the condenser air circuit; a pump-out connection from the room to the intake of the condenser circuit fan; and damper means controlling the pump-out connection and the main inlet to the room air circuit, so arranged that when either is closed the other is open.

2. A unit air conditioner comprising a casing arranged to be mounted in an opening in the wall of a room with its outer end open and thus exposed to air outside the room, said casing having a discharge opening at its front and an inlet opening at its top, both within said room; a refrigerative circuit comprising an evaporator extending across said discharge opening, a condenser extending across said open outer end and means in the casing for drawing volatile refrigerant from said evaporator and delivering it at higher pressure to the condenser; a fan for circulating air over said condenser; means defining a path for air thus circulated, said path passing beneath a portion of the inlet opening and thence to the fan; a fan for circulating air over the evaporator; means for defining the path of air so circulated, such path being from the remaining portion of the inlet opening to the second named fan, and thence over the evaporator to said discharge opening; and a damper serving to close selectively the portion of the inlet opening above the condenser air path, and the remaining portion thereof which leads to the evaporator air path.

3. A unit air conditioner comprising a casing arranged to be mounted in an opening in the wall of a room with its outer end open and thus exposed to air outside the room, said casing having a discharge opening at its front and an inlet opening at its top, both within said room; a refrigerative circuit comprising an evaporator extending across said discharge opening, a condenser extending across said open outer end and means in the casing for drawing volatile refrigerant from said evaporator and delivering it at higher pressure to the condenser; a fan for circulating air over said condenser; means defining a path for air thus circulated, said path passing inward through a portion of said condenser, thence in communication with a portion of said inlet opening to the fan and from the fan outward through another portion of the condenser; a fan for circulating air over the evaporator; means for defining the path of air so circulated, such path being from the remaining portion of the inlet opening to the second named fan, and thence over the evaporator to said discharge opening; and a damper serving to close selectively the portion of the inlet opening above the condenser air path, and the remaining portion thereof which leads to the evaporator air path.

4. A unit air conditioner comprising a casing arranged to be mounted in an opening in the wall of a room with its outer end open and thus exposed to air outside the room, said casing having a discharge opening at its front and an inlet opening at its top, both within said room; a refrigerative circuit comprising an evaporator extending across said discharge opening, a condenser extending across said open outer end and means in the casing for drawing volatile refrigerant from said evaporator and delivering it at higher pressure to the condenser; a fan for circulating air over said condenser; means defining a path for air thus circulated, said path passing inward through a portion of said condenser, thence in communication with a portion of said inlet opening to the fan and from the fan outward through another portion of the condenser; a fan for circulating air over the evaporator; means for defining the path of air so circulated, such path being from the remaining portion of the inlet opening to the second named fan, and thence over the evaporator to said discharge opening; a damper serving to close selectively the portion of the inlet opening above the condenser air path, and the remaining portion thereof which leads to the evaporator air path; and damper controlled means for admit-

ting air from outside the room to the intake of the second named fan.

5. In a unit air conditioner of the window sill mounted type, the combination of a casing approximately square as viewed in plan and having an open rear end and inlet and discharge openings at its forward end; means for mounting said unit on a sill beneath a sash with the rear end projecting out of doors and the forward end projecting into the room; means for closing the intervals between the sides of said casing and the sides of the window opening; a refrigerating circuit containing volatile refrigerant and comprising an evaporator mounted within and across the front of said casing between said inlet and discharge openings, a condenser mounted across the open rear end of the casing, a compressor and circuit connections whereby the compressor draws vaporous refrigerant from the evaporator and delivers it at higher pressure to the condenser and the condenser feeds liquid refrigerant to the evaporator; a rotary fan for circulating outside air over the condenser; a motor on whose shaft said fan is mounted; a belt driving connection between said motor and compressor, the motor, fan and compressor when viewed in plan forming an L-shaped group with the motor to the rear of the compressor and the fan to one side of the motor; a motor and fan driven thereby for circulating air over said evaporator and located as viewed in plan within the angle of said L-shaped group; and a partition, angular as viewed in plan, separating the evaporator air circuit from the condenser air circuit.

6. In a unit air conditioner of the window sill mounted type, the combination of a casing approximately square as viewed in plan and having an open rear end and inlet and discharge openings at its forward end; means for mounting said unit in a sill beneath a sash with the rear end projecting out of doors and the forward end projecting into the room; means for closing the intervals between the sides of said casing and the sides of the window opening; a refrigerating circuit containing volatile refrigerant and comprising an evaporator mounted within and across the front of said casing between said inlet and discharge openings, a condenser mounted across the open rear end of the casing, a compressor and circuit connections whereby the compressor draws vaporous refrigerant from the evaporator and delivers it at higher pressure to the condenser and the condenser feeds liquid refrigerant to the evaporator; a rotary fan for circulating outside air over the condenser; a motor on whose shaft said fan is mounted; a belt driving connection between said motor and compressor, the motor, fan and compressor when viewed in plan forming an L-shaped group with the motor to the rear of the compressor and the fan to one side of the motor; a motor and fan driven thereby for circulating air over said evaporator and located as viewed in plan within the angle of said L-shaped group; a partition, angular as viewed in plan, separating the evaporator air circuit from the condenser air circuit; and a damper controlled passage leading within said casing from out of doors to the intake side of the last named fan.

7. In a unit air conditioner of the type mounted on a window sill beneath a raised sash, the combination of a supporting frame adapted to be fixedly mounted on a sill and having confining guides; a case adapted to be guided to and arrested in operative position by said guides, said case enclosing a refrigerative conditioning unit of the compressor, condenser evaporator circuit type and means for circulating room air over the evaporator and outside air over said condenser; closure means for closing the intervals between the sides of said window and said case; and sustaining means for said closure means carried by said case and so arranged as to be positioned in said window opening beneath the sash when the case is positioned by said guides.

8. In a unit air conditioner of the type mounted on a window sill beneath a raised sash, the combination of a supporting frame adapted to be fixedly mounted on a sill and having confining guides; a case adapted to be guided to and arrested in operative position by said guides, said case enclosing a refrigerative conditioning unit of the compressor, condenser evaporator circuit type and means for circulating room air over the evaporator and outside air over said condenser; closure means for closing the intervals between the sides of said window and said case; sustaining means for said closure means carried by said case and so arranged as to be positioned in said window opening beneath the sash when the case is positioned by said guides; a removable gasket support carried by said sustaining means and extending across the top of said case; and a gasket adapted to seal with the sash over its entire width and supported partly by said closure means and partly by said gasket support.

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