June 10, 1952 P. B. MOORE 2,600,316

AIR CONDITIONER

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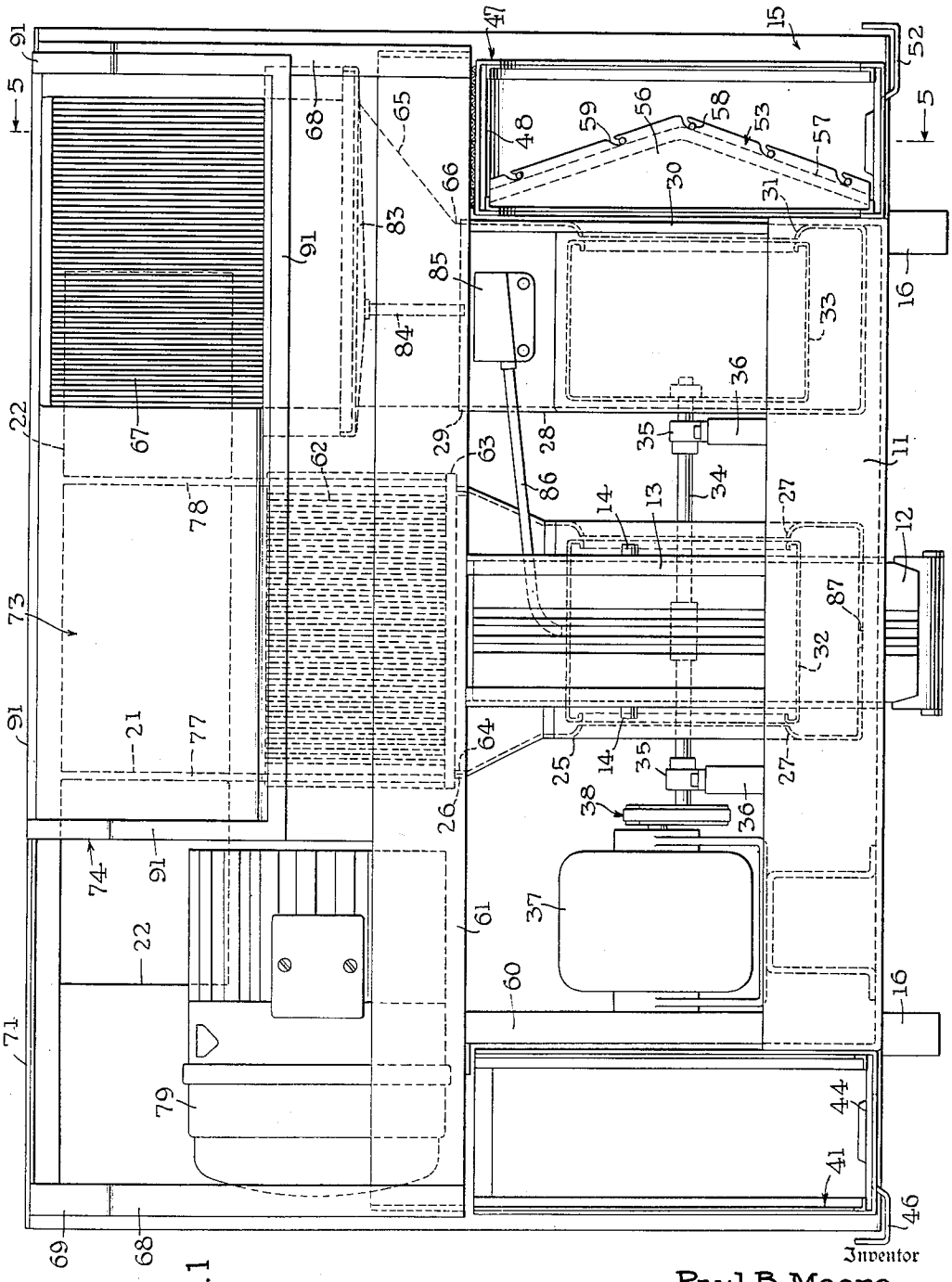


Fig. 1

Inventor
Paul B. Moore

By Dodge and Sons

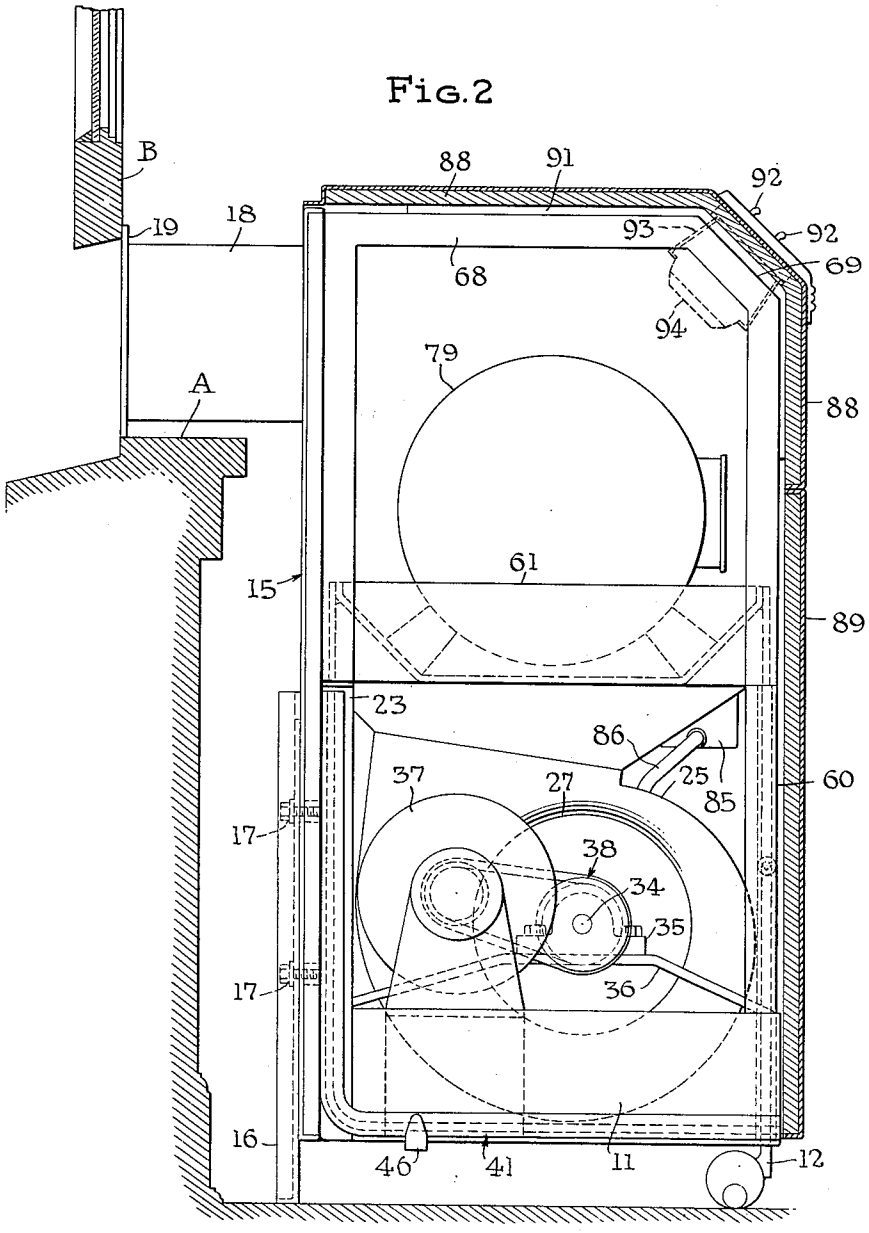
Attorneys

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AIR CONDITIONER

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Fig. 2



Inventor

Paul B. Moore

By Dodge Ald Sons

Attorneys

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AIR CONDITIONER

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Fig. 3

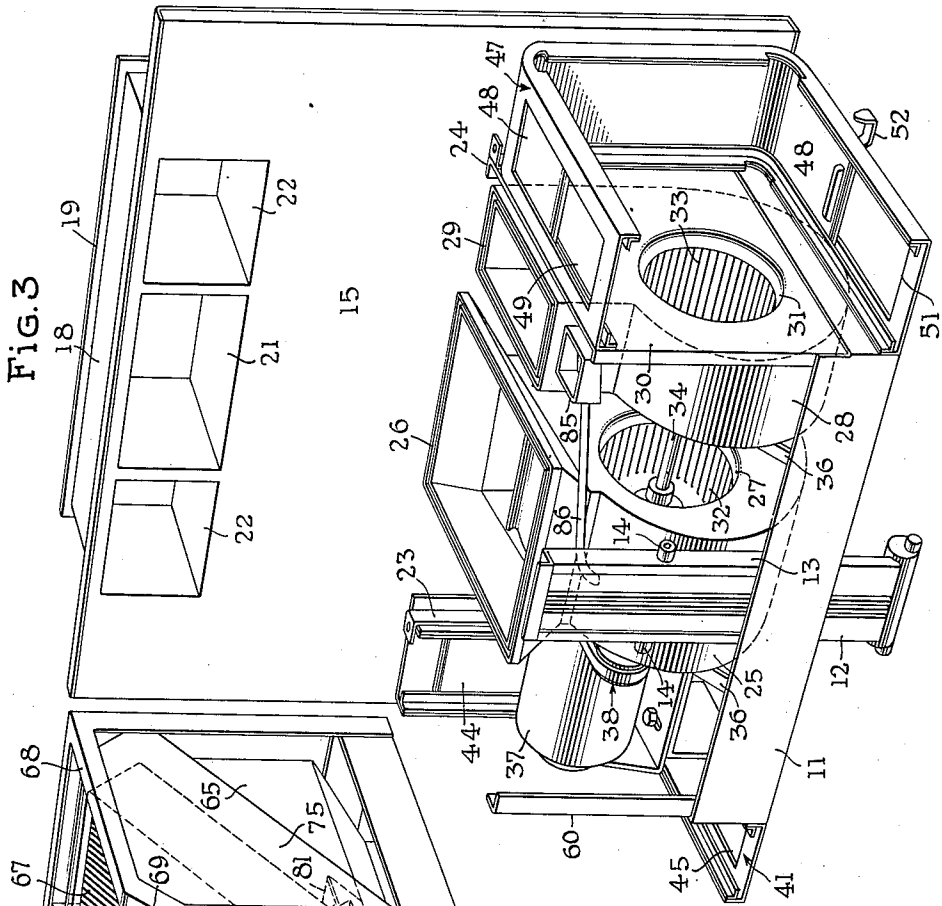
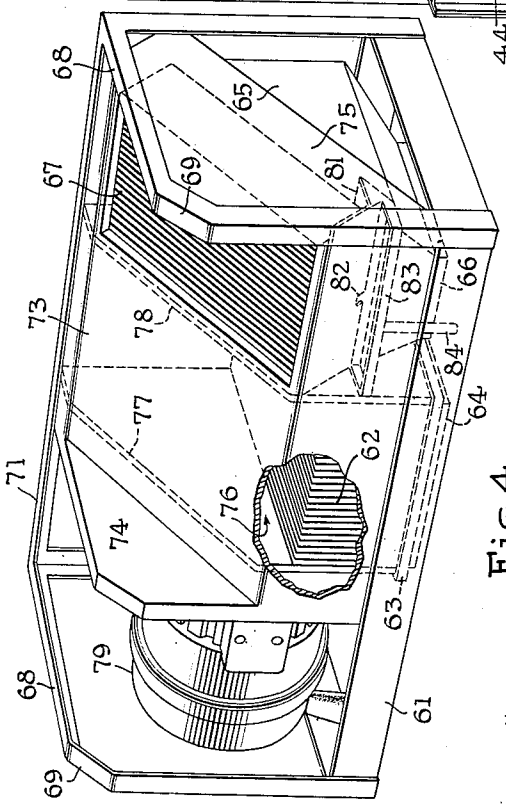


Fig. 4



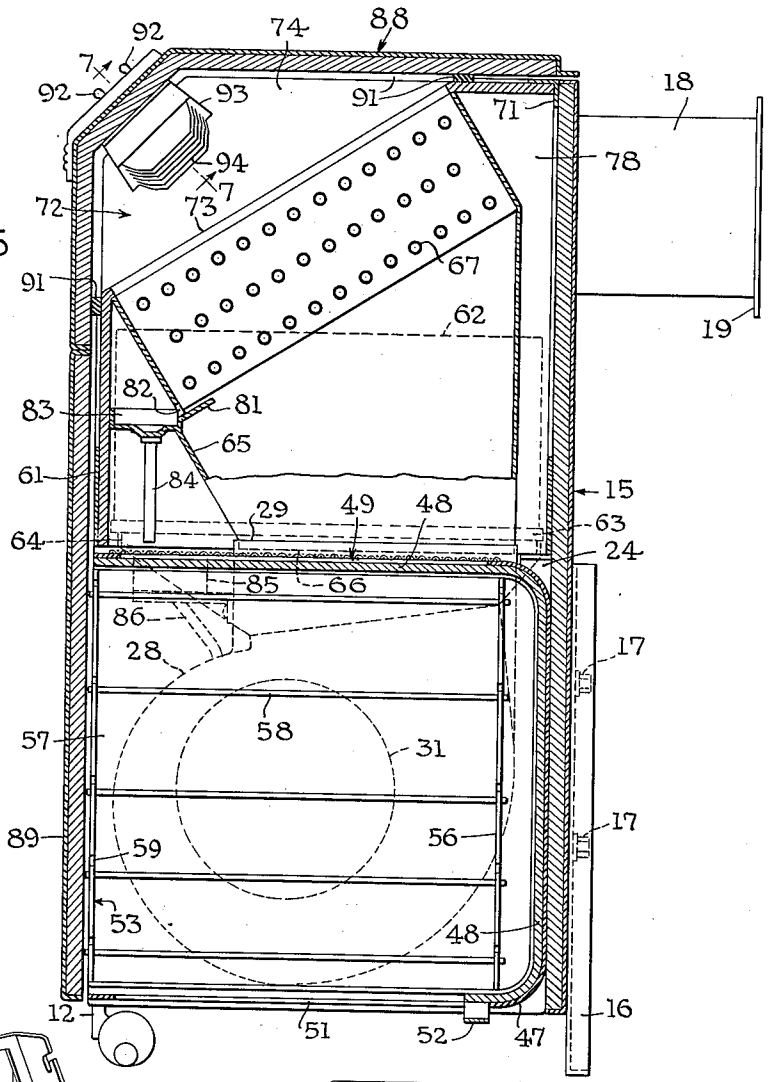
Inventor
Paul B. Moore
By Dodge and Jans
Attorneys

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AIR CONDITIONER

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Fig.5



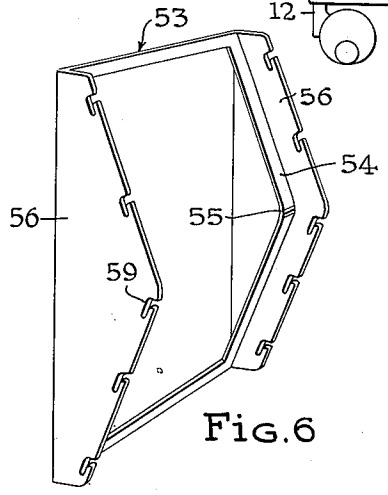


Fig.6

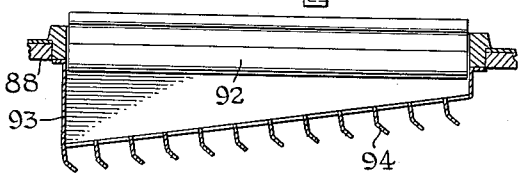


Fig.7

Inventor

Paul B. Moore

By Dodge Reid Inn.

Attorneys

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UNITED STATES PATENT OFFICE

2,600,316

AIR CONDITIONER

Paul B. Moore, York, Pa., assignor to York Corporation, York, Pa., a corporation of Delaware

Application June 16, 1949, Serial No. 99,519

4 Claims. (Cl. 62—129)

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This invention relates to air cooled refrigerative air conditioners and the purpose of the invention is to improve the so-called "console" type of unit conditioner which customarily is positioned beneath a window and rejects heat and moisture through a condenser air circuit which leads through appropriate ports formed in a window board.

Such conditioners customarily include a refrigerative circuit of the compressor-condenser-evaporator circuit type and two air circuits in which the air is propelled by fans. One of these is the condenser cooling circuit which draws air from out-of-doors, causes it to flow in heat-exchanging relation with the condenser and then discharges it out-of-doors. The other is the so-called "room" circuit which derives air from the room or from out-of-doors or from both, causes it to flow in heat-exchanging relation with the evaporator and delivers it to the room at reduced temperature, and with a reduced moisture content.

The evaporator is commonly operated at a temperature near to but above the freezing point of water, so that the evaporator operates most of the time below the dew-point of air which is circulated over it. The resulting drip water must be disposed of, and the customary mode of doing so, is to deliver this drip to the condenser air stream in such a way that the drip will be re-evaporated by the heat rejected through the condenser.

Users demand a compact construction, so that the floor space occupied is small, and so that the obstruction of the lower portion of the window opening is the least practicable. Attempts to meet these space requirements have led to arrangements in which the air circuits and the refrigerative circuits were so crowded together that the service problem was quite difficult. Moreover, standardization of the refrigerative unit was next to impossible, because the air paths for each design of conditioner required special locations for components of the refrigerating circuit.

According to the present invention the refrigerative unit comprising the motor driven compressor, the condenser and the evaporator forms a single self-contained unit which can be removed bodily from the conditioner without breaking any pipe connections whatsoever. This is made possible by removably mounting the unit just described on top of a base structure which contains the condenser-circuit fan, the evaporator or room-circuit fan, the motor which drives these fans, all the dampers which control the admission

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of fresh air, room air and the mixture of the two, the pump-out damper and connections to the window board. Even the filter for the room air circuit is mounted in this base.

As a result of this concept, and without increase in the cubage occupied by the console it becomes possible to construct the refrigerative unit so that it can be lifted off the base and removed without preparatory steps other than lifting off the decorative casing. Since the refrigerative circuit unit is the most expensive part of the conditioner, the possibility of standardizing this unit greatly simplifies the problem of furnishing specially dimensioned conditioners to meet special installation requirements.

The base which carries the fans and window-board connections has adjustable legs to accommodate any ordinary range of window sill height. Special installations outside this normal adjustment range can be made with very little special equipment beyond a special decorative casing. Moreover, since the refrigerative unit includes no fans and practically no duct-work, it is available as a unit for a wide variety of installations other than the particular one now about to be described.

A console unit embodying the principles of the invention is illustrated in the accompanying drawings, in which:

Fig. 1 is a front elevation of the conditioner, complete except that the enclosing cabinet has been removed.

Fig. 2 is a view of the left-hand end of the unit. In this view the left-hand end of the cabinet is cut away, and the top and front portions of the cabinet are shown in section.

Fig. 3 is a perspective view of the base unit of the conditioner which includes all fans, the fan motor, the dampers and the rear panel, together with the connections to the window-board which are carried by the rear frame. The parts are shown as they would appear after removal of the refrigerative-circuit unit.

Fig. 4 is a similar perspective view of the refrigerative-circuit unit, as it appears when removed from the base unit.

Fig. 5 is a vertical section taken on the plane indicated by the line 5—5 of Fig. 1. In this view the rear panel and the cabinet are shown in section.

Fig. 6 is a perspective view of the frame in which the air filter is removably mounted.

Fig. 7 is a section through the room-air discharge-louver structure. The plane of section is indicated by the line 7—7 in Fig. 5.

The three major components of the conditioner

comprise the base unit shown in Fig. 3 which is mounted on vertically adjustable legs so as to be adaptable to various window sill heights, the refrigerative-circuit unit shown in Fig. 4 (which is supported on the unit shown in Fig. 3), and a cabinet (sometimes called a decorative casing) which covers the front, top and both ends of the conditioner made up of the two units just mentioned.

The main frame structure of the unit shown in Fig. 3 comprises a generally rectangular base pan 11 which is supported by three legs adjustable vertically relatively to the pan 11. The front leg 12 is adjustable vertically in a channel guide 13. As best shown in Figs. 1 and 3 it may be clamped in place by clamp screws which appear at 14 and which may take any suitable form.

The vertical back-panel 15 is rigidly connected to the rear of the pan 11 and carries, at opposite rear corners of the conditioner, two legs 16, one of which is shown in Fig. 2 and the other in Fig. 5. These legs are adjustable, upon releasing machine screws 17 which are threaded into the rear panel 15 and pass through longitudinal slots formed in the legs 16. The construction is conventional so far as leg-adjustment is concerned.

The use of three vertically adjustable legs is preferred because it simplifies the problem of leveling the unit.

The back-panel forms a closed wall, but has near its top, a rearward duct-enclosing extension 18 which leads from openings in the back-panel and terminates in a panel 19. As best shown in Fig. 2 the panel 19 rests on the window sill A and seats against the inner face of the sash B. Horizontally this panel should be dimensioned to extend the full width of the window opening.

The present invention is not concerned with window connection details, and these can follow any of the arrangements common in the art. So far as this application is concerned, the significant thing is that the extension 18 leads out of doors, and houses at least two parallel ducts. The illustrated embodiment has three ducts; a central duct 21 which is the discharge passage for condenser air, and two inlet ducts 22, one on each side of the duct 21. Some of this inlet fresh air flows over the motor compressor unit to the condenser fan and is discharged through the duct 21. Some, entering through the right-hand duct 22, can flow directly to the fresh air damper and, if this damper is open, may enter the evaporator air stream which flows to the room. However, both ducts 22 lead to the interior of the cabinet and supply air to the condenser circuit fan.

Adjustment of the legs 12 and 16 is the only means provided to insure that the height of the duct member 18 is properly coordinated with the height of the sill A. The range of sill heights normally encountered where console type installations are appropriate can be provided for in this way.

Supported by the pan 11 are two upright frame members 23 and 24. The tops of the frame members 23 and 24 and the top of the channel member 13 define a horizontal plane which, for lack of a better name, will be hereinafter called the "junction plane." Supported by the pan 11 is the snail-shell housing 25 of the condenser fan. This has a flared mouth which terminates in joint channel 26 at the "junction plane." The housing 25 has entrance eyes 27 at both sides as clearly shown in Fig. 1. The snail-shell housing 28 of the evaporator fan is also supported in the pan 11 and likewise has a mouth which terminates in a joint channel 29 at the "junction plane." The fan housing 28 has in its right side a plate 30 which forms a part of the frame structure and has the single entrance eye 31. See Figs. 1 and 3.

The bladed rotor 32 of the condenser fan and the bladed rotor 33 of the evaporator fan are fixed on a shaft 34. The shaft 34 passes through the left-hand wall of the evaporator fan housing 28 and is supported by bearings 35 carried by brackets 36 attached to the pan 11. An electric motor 37 is sustained on a base attached to the pan 11 and drives the shaft 34 at a somewhat reduced rotary speed through a conventional V-belt drive generally indicated by the numeral 38 in Figs. 1 and 2.

Two damper frames, one mounted on each end of the pan 11 are provided. The pump-out damper frame 41 is associated with the member 23 and comprises an L-shaped channel in which a flexible strip-damper 44 is movable. This damper controls an air inlet 45 through which air may enter the conditioner cabinet from the room, and flow to the condenser fan. The damper member 44 may be moved by an actuator 46, which is attached to it and projects, beneath the guide member 41, past the lower edge of the cabinet so as to be readily accessible. The general arrangement of the damper is indicated quite clearly in Figs. 1, 2 and 3.

At the opposite end of the pan 11 and associated with member 24 is a proportioning damper which controls the flow of fresh and return air to the eye 31 of the evaporator fan. A U-shaped member 47 affords a channel guide for a flexible strip damper 48. This damper controls a fresh-air inlet opening 49 which is supplied with fresh air by one or both of the ducts 22 and a room-air inlet opening 51 which admits air from the room. The damper strip 48 is of such length that when it closes one of the ports 49 or 51 it completely opens the other. At intermediate settings it opens both inlets in complementary fractions. An actuator 52 attached to the damper strip 48 extends beneath the frame 47 and the lower margin of the cabinet to an accessible exterior point. Either or both of the damper mechanisms can be omitted, so far as the present invention is concerned.

The top portion of the fame 47, in which the fresh air inlet opening 49 is formed, lies in or just below the junction plane above defined. Within the U-shaped damper frame 47 there is mounted a filter frame generally indicated by the numeral 53. The position of the frame 53 is indicated in Fig. 1. It comprises an open rectangular flange member 54 bent at 55 so as to define a dihedral angle and attached to respective vertical plates 56. The filter 57 whose position is indicated in dotted lines in Fig. 1 is mounted against the frame 54 and is retained by rods 58 which are dropped into alined undercut notches 59 formed in the end plates 56.

In order that the operation of replacing the filter shall not require the removal of the entire cabinet, the latter is provided with a removable front panel as will be hereinafter explained. The filter may be of any ordinary type and may or may not be constructed in one piece. Its only unusual characteristic is the location of the filter in two planes at an angle to one another. This arrangement is adopted to secure a large total filter area, without obstructing either the fresh-air opening 49 or the return-air opening 51. This filter arrangement though convenient is not in-

dispensable. Various expedients for affording easy replacement of the filter may be adopted.

As has already been explained, the tops of the support members 13, 23 and 24 are all in the common plane which has been called the junction plane. The same is true of the corner strut 60, best shown in Fig. 3 and the plate 30 which last not only forms the side of the evaporator fan housing but also acts as a frame bracing member and as a partition between the inlet chamber and other portions of the interior of the cabinet.

The refrigerative unit shown in Fig. 4 has a rectangular bottom frame 61 with bracket portions which rest on the upper ends of the supporting members 13, 23 and 24. The finned condenser 62 has a boundary frame which appears at 63 and the lower margin of this frame has a tongue-like rim 64 which enters the joint channel 26 formed in the upper margin of the condenser fan housing 25. Also mounted in the frame 61 is a flaring duct structure 65 which has at its lower end a rim 66 adapted to enter the joint channel 29 at the upper margin of the evaporator fan housing 28. The finned tubular evaporator 67 is mounted in an inclined position across the upper portion of the flaring duct 65.

It follows that when the unit shown in Fig. 4 is set upon the unit shown in Fig. 3, the condenser is interposed in the path of discharge from the condenser fan and the evaporator is interposed in the path of discharge from the evaporator circuit fan and approximately air-tight joints are produced. Any other readily separable joint characterized by reasonable tightness can be substituted. It is preferred to avoid bolted connections as indicated but the strict avoidance of such connections is not absolutely essential.

It will be observed that to the right of the flaring extension 65 there is a space through which air may pass from the right-hand air inlet 22 to the fresh air damper opening 49.

Again referring to Fig. 4, it will be observed that the frame member 61 carries two frame structures 68 one at each of its opposite ends. The form of the frame structures 68 is determined by the outline of the top of the console and since the console here illustrated has a beveled front edge, the frame members 68 are similarly formed as indicated at 69. The frame members 68 are braced together by a longitudinal member 71 at the rear of the unit and immediately in front of the upper margin of the back panel 15 when the base unit and the refrigerative unit are assembled. See Fig. 5.

It is necessary that air discharging from the evaporator 67 be conducted to the exit louvers in the cabinet and since these exit louvers are located approximately at mid-length of the front of the cabinet, there must be a plenum space 72 which leads from the end of the cabinet interior above the inclined evaporator 67 to a point beyond the ends of the exit louvers. This result is secured by using an inclined thermally insulated panel 73 which is formed with an aperture registering with the evaporator 67 and two end panels 74 and 75.

The panel 73 with the panels 74 and 75 is removable as a unit. It will be observed that the panel 73 separates the plenum space 72 from the condenser discharge passage 76 whose lateral margins are defined by the partitions 77 and 78 best illustrated in Figs. 1 and 4. The partitions 77 and 78 seat against the rear panel 15 and overlie the dividers which separate the end passages 22 from the middle passage 21, see Fig. 3.

It follows from the above construction that air discharged by the condenser fan flows upward through the condenser 62, is then deflected to the rear by the inclined partition 73 and flows out of doors through the middle passage 21. Out-door air enters through the passages 22 and flows directly to both eyes 27 of the condenser fan.

The evaporator fan 33 receives air through the fresh-air opening 49 or the room-air opening 51 or from both (according to the position of the damper 48). This air flows through the filter 57 to the eye of the evaporator fan 33. The fan discharges through the flaring duct 65. This air flows in heat-exchange relation with the evaporator 67 and into the plenum space 72. Before explaining how this plenum space is enclosed, as it must be, the description of the unit shown in Fig. 4 will be completed.

The unit indicated at 79 is a motor driven compressor of the hermetically enclosed type. In these units the motor and the compressor are both sealed within an air-tight casing so that no packing gland for the compressor shaft is required. This construction is familiar in the refrigerating art and requires no explanation except a statement that the member 79 typifies the compressor and its driving motor. It is considered good practice to use such a unit but any appropriate motor driven compressor could be mounted in the space at the left of partition 74 without affecting the invention here claimed in any respect.

In order to avoid complicating the drawings with immaterial details, the conventional piping connections from the compressor to the condenser, from the condenser to the evaporator and from the evaporator to the inlet of the compressor are omitted.

Refrigerant compressed by the compressor in unit 79 is fed to the condenser 62 where it gives up heat to the condenser air stream and liquefies. Refrigerant so liquefied is supplied by any suitable expansion controlling means to the evaporator 67. Since the evaporator is connected to the suction intake of the compressor in the unit 79, refrigerant entering the evaporator 67 in the liquid phase evaporates and in evaporating absorbs heat from the evaporator air stream. Perhaps it would suffice simply to say that the refrigerating circuit is a conventional compressor-condenser-evaporator circuit type. Its details are unimportant and any of the useful expedients known in the refrigerative art may be adopted. No claim of novelty is predicated on any detail of the refrigerative circuit proper.

Since the evaporator 67 operates commonly below the dew point of air circulated in contact with it, a considerable amount of moisture condenses on the fins of the evaporator. It drains down these fins to the lowermost corner where it is collected in a trough formed by the flange 8. The flange 81 projects into the air stream and shields the collected water from that air stream. The drip water so collected passes through a small opening 82 formed in the enclosing frame of the evaporator and enters a drain pan 83, best shown in Fig. 5.

A drip pipe 84 leads from the drain pan 83 and overlies a funnel 85 mounted in the base unit and clearly shown in Fig. 3. The funnel unit 85 is connected by a tube 86 with the housing 25 of the condenser fan. The collected drip is discharged directly on the rotor 32 of the fan

and so is atomized and re-evaporated in the condenser air stream. The bottom of the fan housing 25 is provided with a slot 87 so that the base pan 11 of the lower unit can serve as a reservoir. Any drip water not evaporated immediately will be retained by this pan and fed back through the slot 87 to the condenser fan. Thus, while is is expected that the drip will be re-evaporated as it is delivered from the evaporator, provision is made for its accumulation and ultimate evaporation in any case.

As best indicated in Figs. 2 and 5 the cabinet 88 is a sort of mask which covers the top, the front and both ends of the conditioner unit but is itself open at the back. As clearly shown in the drawings the rear panel 15 is engaged at its top and side margins by the cabinet 88. Generally stated the entire space within the cabinet is open to out of doors through the passages 22 except for the condenser air duct, the evaporator air duct with its connected plenum space and the inlet air space to the right of plate 30 and within damper frame 47. It follows that air flowing to the condenser serves to cool the motor compressor and the fan motor. For convenience in servicing the filter and the fan motor and fan shafts, which are the only units requiring lubrication, the cabinet 88 is provided with a removable front panel 89.

The plenum space 72 already mentioned is enclosed by the cabinet element 88, as clearly shown in Fig. 5, both at the top and at the front of the plenum space. Inclined partition 73 defines its rear and bottom and its two ends are defined by the insulated partitions 74 and 75 which as stated are preferably constructed as a unit with the panel 73. In order to prevent leakage of refrigerated air from the plenum chamber, a gasket 91 forms a seal completely around the margin of the plenum chamber. The gasket is shown in section and elevation in Fig. 5 and it will be understood that it extends across both horizontal margins of the panel 73 and over the tops of panels 74 and 75 and seals with the cabinet 88 throughout its length.

The air delivered through the evaporator to the plenum chamber discharges to the room to be conditioned between louvers 92. These louvers are preferably pivoted on their longitudinal axes so that they can be inclined variously to direct the discharging conditioned air according to the preferences of the room occupant. The louver arrangement is shown in Figs. 5 and 7. Because the air flows lengthwise of the plenum chamber 72 from the evaporator 67 to the louvers 92, a shroud 93 is mounted below the louvers within the plenum space 72 and is provided with a series of offset scoop fins 94 which are designed to afford approximately even distribution of the dicharge flow throughout the length of the louvers 92.

The arrangement is compact and simple and has the advantage that the refrigerative circuit is constructed as a unit separable from all other mechanical parts which are also constructed as a unit. This facilitates standardization of the refrigerative unit without imposing too rigid standards on the other two main components, and so permits diversified arrangements and use of special ornamental treatments on occasion.

Although surface treatment of components for sound-deadening purposes is contemplated, it is not indicated in the drawings since it is common practice in the art. That portion of the evaporator air circuit which is adjacent the evaporator and beyond the evaporator is insulated to minimize heat leakage. This is familiar practice for which no novelty can be claimed and accordingly the detail is not elaborated in the drawing.

The refrigerative circuit unit including portions of the two air ducts is a novel concept in itself and can be used in a number of specifically different environments. Such an arrangement has the advantage that the unit is removable for service and can readily be replaced with an identical unit. It has the further advantage that the design and arrangement of the refrigerative circuit are not even remotely affected by design details of fans, dampers, fan motors and other adjuncts.

I claim:

1. In a room air conditioner comprising a housing having inlet and outlet connections from and to out-of-doors and inlet and outlet connections from and to the room, a refrigerative circuit including compressor, condenser and evaporator, a condenser air circuit and fan interposed between the outdoor inlet and outlet and arranged to circulate outdoor air in heat-exchanging relation with the condenser, an evaporator air circuit and fan interposed between the inlet and outlet connections from and to the room and arranged to pass room air in heat-exchanging relation with the evaporator, a motor for driving the compressor and motor means for driving said fans; the improvement which consists in constructing said conditioner in at least two self-contained readily separable sections, a base section and a refrigerant unit section, said base section comprising as an assembled unit means providing both connections to out-of-doors and the inlet connection from the room, both fans and the fan-driving motor means, and said refrigerant unit section comprising as an assembled unit the compressor, its driving motor, the condenser, a portion of the condenser air circuit duct between the condenser fan discharge and the outdoor discharge connection, the evaporator and a portion of the evaporator air circuit duct between the discharge of the evaporator fan and the outlet to the room, said base section including a positioning support for the refrigerant unit section, and the air duct connections to the latter section being so arranged as to be established by setting the refrigerant unit section in place on said support.

2. In a room air conditioner the combination of a base section constructed as a self-sustaining unit and comprising a frame structure, a rear wall for the conditioner formed with distinct inlet and outlet air flow connections adapted for connection to out-of-doors, two air circulating fans each including a flow directing housing, and motor means for driving said fans; a refrigerating section constructed as a self-sustaining unit adapted to be removably assembled with said base section and comprising a frame structure, a self-contained refrigerative unit of the compressor-condenser-evaporator circuit type, motive means for the compressor of said refrigerative unit and duct forming means adapted when the two sections are assembled to register with appropriate fan housings and air flow connections in said base unit to define an enclosed path from the first of said fans, through the air path of the condenser and to said outlet flow connection, and an enclosed path from the second of said fans through the air path of the

evaporator; and a casing removably mounted and serving, in conjunction with the partial housing of the base section, to enclose said sections and afford an enclosed path from said inlet flow connection to the inlet of the housing of the first fan, and a separate enclosed path from the room to the inlet of the housing of the second fan, said casing having a discharge opening for air flowing from the air path of the evaporator.

3. A room air conditioner comprising in combination two distinct sections capable of assembly with one another, the first of said sections comprising a supporting frame, a condenser-air circulating fan, an evaporator-air circulating fan, motor means for driving said fans, and inlet and outlet connections and ducts associated with said fans; a second section comprising a frame adapted to be associated with the frame of the first section, a refrigerative unit of the compressor-condenser-evaporator circuit type, a motor for driving the compressor of said unit and duct forming means adapted to coact with ducts and connections, as the case may be, of the other section; and housing means for enclosing said sections, comprising separable parts, one of which is a wall attached to one of said distinct sections and carrying inlet and outlet connections for the condenser air circulating fan, and the remainder forms an open-sided shell attached to said wall at the margins thereof and having an outlet opening for air circulated by the evaporator air circulating fan.

4. A room air conditioner comprising in combination two distinct sections capable of assembly with one another, the first of said sections comprising a supporting frame, a condenser-air circulating fan, an evaporator-air circulating fan, motor means for driving said fans, inlet and outlet connections and ducts associated with said fans, and damper means mounted wholly in said section and associated with at least one of said fans; a second section comprising a frame adapted to be associated with the frame of the first section, a refrigerative unit of the compressor-condenser-evaporator circuit type, a motor for driving the compressor of said unit and duct forming means adapted to coact with ducts and connections, as the case may be, of the other section; and removable housing means for enclosing said sections.

PAUL B. MOORE.

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