United States Patent [19]

Thomas

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[54] **AIR CONDITIONER ADAPTED FOR THROUGH-FLOOR INSTALLATION**

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[52] **U.S. Cl.** **62/239;** 62/244; 62/279; 165/41; 62/285

[51] **Int. Cl.** **B60h 3/04**

[58] **Field of Search** 62/239, 244, 279; 165/41, 165/42

[56] **References Cited**

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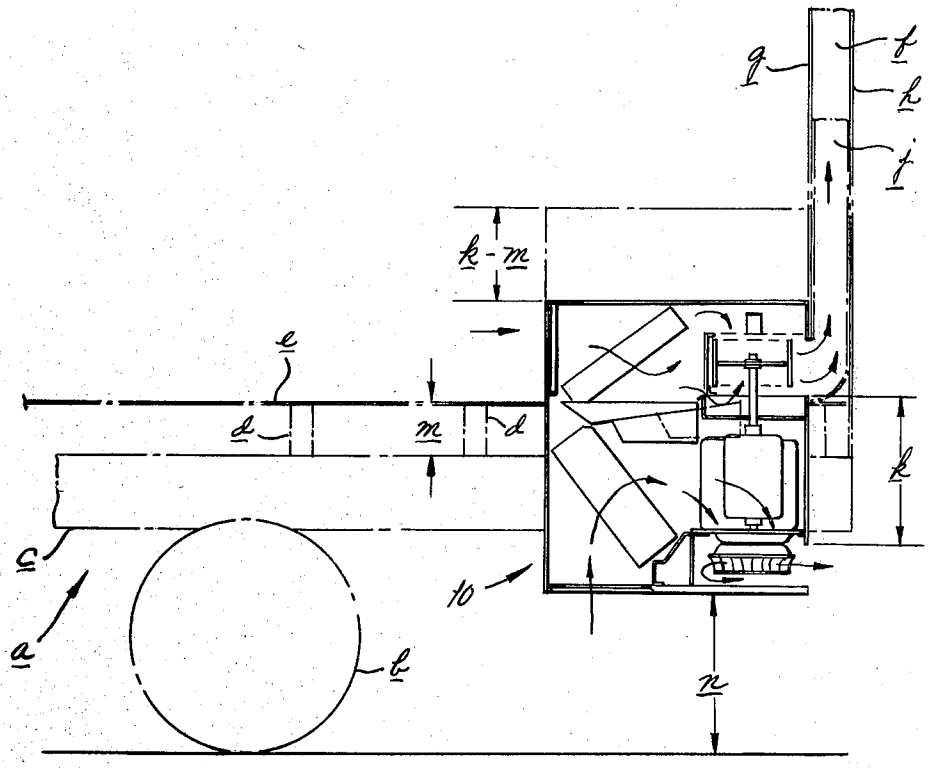
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Primary Examiner—William J. Wye

[57] **ABSTRACT**

For air conditioning recreational vehicles and other interior spaces beneath whose floors there is open air space, a unitary, through-floor air conditioner is provided. Adjustable vertically, only its upper evaporator compartment need be within the room space; hence removable furniture may be positioned above it. For servicing, the blowers and their motor, with intermediate divider walls, lift out vertically as a unitized assembly. Removal of this assembly provides access for servicing the other components.

7 Claims, 6 Drawing Figures



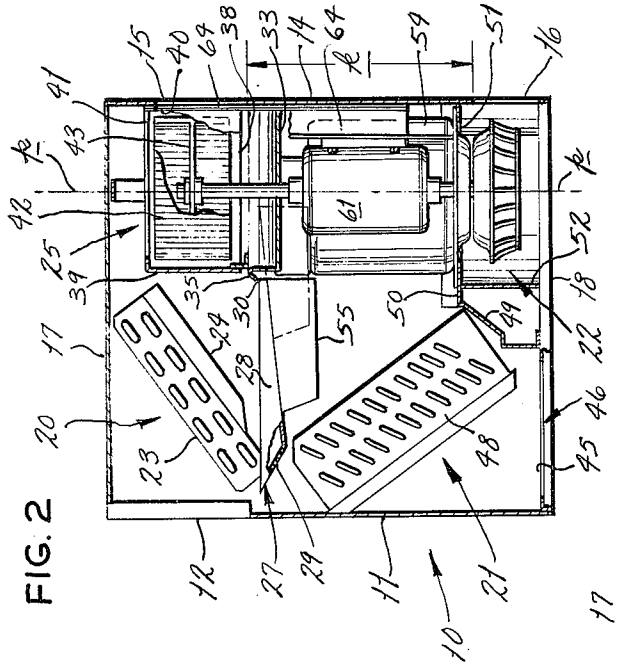


FIG. 2

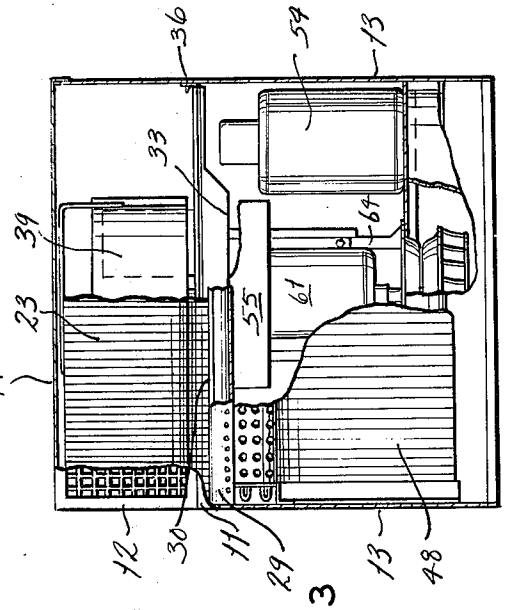


FIG. 3

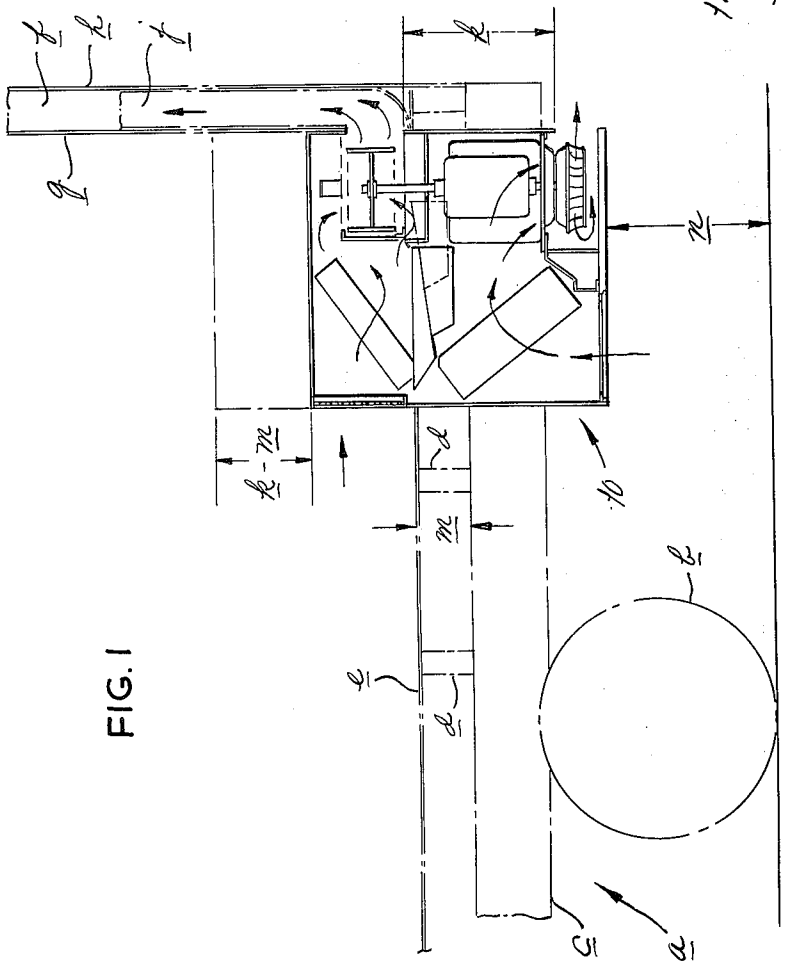


FIG. 1

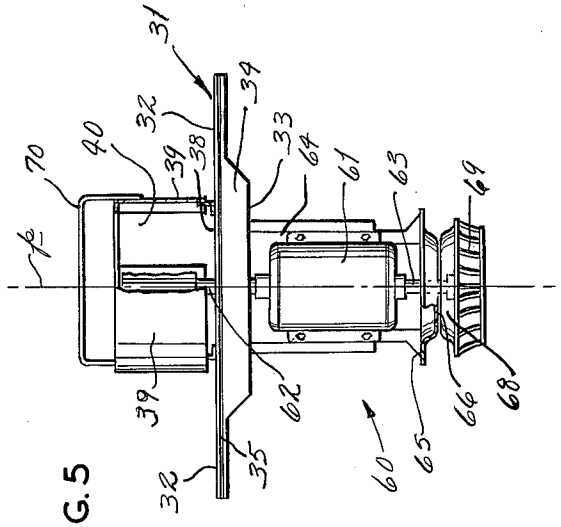


FIG. 5

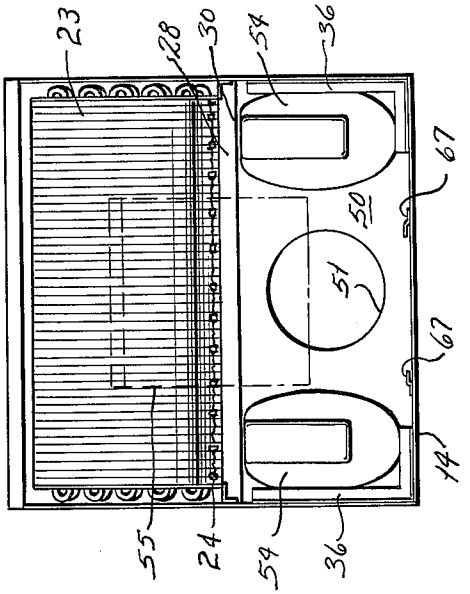


FIG. 6

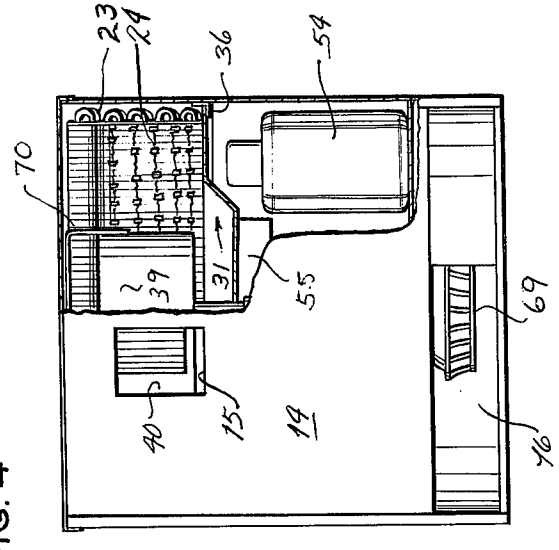


FIG. 4

AIR CONDITIONER ADAPTED FOR THROUGH-FLOOR INSTALLATION

BACKGROUND OF THE INVENTION

This invention relates to air conditioners of the unitary type, in which an evaporator compartment and a condenser compartment are in the same cabinet. It is concerned with the design of such a unitary air conditioner adapted to be installed through a floor, as in a recreational vehicle or in a housing unit wherein there is an open air space below the floor of the interior to be cooled.

Heretofore such vehicles have used other types of air conditioners than those used in ordinary homes. For example, roof-mounted air conditioner units have been used; and some mobile homes have used unitary air conditioners placed on the surface beneath the home with large flexible ducts to draw the warm air from the interior and to supply refrigerated air to it. For these types of installations, respectively, reference is made to U.S. Pat. Nos. **3,216,216** and **3,566,614.**

As will hereafter be described, the present through-floor air conditioner positions the evaporator section above the compressor section. In a different way as in U.S. Pat. No. **3,018,642,** an air conditioner has heretofore been provided which contains, in a single cabinet, an evaporator and blower above and a condenser and blower below. Height differences in the arrangement of components within the cabinet of a unitary air conditioner are also shown in U.S. Pat. No. **3,756,039.**

SUMMARY OF THE INVENTION

The objects of the present invention include providing an air conditioner for through-floor installation; one which requires a minimum of interior space above the floor and may be accommodated beneath removable furniture; one which may be adjusted upward to provide greater ground clearance; one which may discharge the cooled air into a wall duct for distribution to all the interior space; one which takes advantage of its vertical arrangement to provide the direct dripping of the condensate from the evaporator coil onto the condenser coil; one which draws the condenser cooling air from below and discharges it sideward to avoid intermixture; and one in which a vertically removable motor and dual blower assembly is provided, for easy servicing of the removed assembly and for access to the portions not so removed.

To summarize the present invention briefly and without limiting its scope, I provide a cabinet having removable top wall, and upper evaporator compartment whose forward portion has an air inlet and a lower surface defined by an upper partial partition, and a condenser compartment therebeneath whose forward portion has an air inlet and whose lower aft surface has an air discharge opening. In the evaporator compartment adjacent to its forward air inlet, the evaporator coil is positioned; the condenser coil is positioned directly beneath it in the condenser compartment, and the partial partition therebetween has perforations which permit the dripping, directly onto the condenser coil, of condensate from the evaporator. Except for the blowers, the remaining conventional components are positioned in the evaporator compartment.

At the rear of the cabinet is positioned a vertically removable assembly including a blower motor which has its shaft oriented vertically, with upward- and downward-extending shaft portions. Above the motor is a divider, which (when the assembly is in place) is at the level of the upper partial partition and serves to complete it, to seal the evaporator compartment from the condenser compartment. A centrifugal blower assembly is provided thereabove, leading horizontally to a rear outlet for the cooled air. At the lower end of the downward-extending shaft portion is a discharge blower, which impels downward the air which has been warmed by passing through the condenser. In the preferred embodiment the discharge blower is located in a side-discharge compartment, directly below a bottom wall opening in the condenser compartment; this avoids mixing with the air being drawn upward and through the condense.

For servicing, the air conditioner top wall is removed and the motor-blower-divider assembly is lifted out vertically for easy servicing. This also provides access to the fixed components, expecially those within the condenser compartment.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic cross-sectional view of a through-floor air conditioner, as installed in the floor of a recreational vehicle shown in phantom lines.

FIG. **2** is an interior side view, partly in elevation and partly in section, of the air conditioner of FIG. **1,** shown enlarged and with certain portions broken away.

FIG. **3** is a front view thereof, as seen from the left side of FIG. **2,** with portions thereof broken away successively from the left to the right side of said view.

FIG. **4** is a rear view thereof.

FIG. **5** is a front view of the lift-out assembly whose side view is included in FIG. **2.**

FIG. **6** is a plan view as seen after removal of the top wall and the lift-out assembly of FIG. **5.**

DESCRIPTION OF THE PREFERRED EMBODIMENT

A recreational vehicle generally designated *a* and whose rear portion is shown in phantom lines in FIG. **1** may have suspended on springs, not shown, above its wheels *b* a framework including a plurality of longitudinal beams *c* and lateral joists *d* beneath a plywood floor *e*. Such a recreational vehicle *a* may have vertical wall studs *f* supporting inner and outer wall panels *g*, *h* in which may be accommodated a conventional sheet metal distributor duct *j* shown therebetween in FIG. **1.**

Installed through the plywood flooring *e* spacedly between such longitudinal beams *c* is the present through-floor air conditioner generally designated **10** whose arrangement is best seen in the enlarged view FIG. **2.** It includes a front cabinet wall **11** having across its upper portion an air inlet grill **12;** a pair of side cabinet walls **13;** a rear wall **14** best seen in FIG. **4** whose upper portion is penetrated by a cooled air outlet opening **15** and whose lowermost wall portion has a condenser air discharge outlet **16;** a removable imperforate top wall **17** and a fixed aft bottom wall **18.** Common to the front wall **11,** the two side walls **13** and the rear wall **14** is a depth *k* over which said walls are imperforate, as seen in FIGS. **1** and **2.** To the extent that this portion *k* exceeds the total thickness *m* of the floor system, the air conditioner unit **10** may be installed over the height range *k–m*, shown in FIG. **1.**

At its lowest height of installation, shown in solid lines in FIG. **1,** a ground clearance *n* will be provided;

and in this position the air conditioner unit **10** will occupy only a small amount of interior space within the vehicle *a*, the necessary depth being only that of the air inlet grill **12.** In such lowest installed position, in which the ground clearance is shown by the dimension *n*, removable furniture such as a sofa may occupy the space above the unit **10.** The elevated position, shown in phantom lines in FIG. **1,** provides an increase by the amount *k–m;* this still leaves the discharge opening **16** below the floor joists *d.*

The cabinet of the unit **10** includes an upper evaporator compartment generally designated **20,** and a condenser compartment therebeneath generally designated **21.** In addition, the preferred embodiment has an air outlet compartment generally designated **22** beneath the aft portion of the condenser compartment **21.**

The evaporator compartment **20** contains a room air inlet grill **12** in the forward wall **11** and a cooled air outlet opening **15** in the rear wall **14,** communicating with the wall distributor duct *j.* Within the compartment **20** beneath the removable top wall **17** and behind a conventional filter, not shown, is a conventional evaporator coil **23** tilted rearwardly to minimize the depth of the compartment **20.** At its rear side is optionally mounted an electric heater coil **24,** consisting of a conventional resistance heater, not shown in detail. Aft of the evaporator **23** and heating coil **24** is a centrifugal blower, generally designated **25** and hereafter described, which discharges through the cooled air outlet opening **15.**

The evaporator compartment **20** terminates downwardly in a fixed partial partition **27** composed of two principal parts. The first is a drip pan wall **28** which slopes forwardly to a perforated forward portion **29,** proximately beneath which a condenser coil, hereafter referred to, is located. The drip pan wall **28** has a horizontal rear edge **30** which defines the front edge of an upper access opening, seen in the plan view FIG. **6.**

To fill out the partial partition **27** and form a complete partition by which the evaporator compartment **20** is separated from the condenser compartment **21,** an upper removable divider **31** is provided as part of the vertical removable assembly shown in FIG. **5** and hereafter described. The removable divider **31** is best seen in FIGS. **4** and **5.** It includes two planar horizontal side portions **32** separated by a central depressed portion **33** whose forward wall **34** extends downward from a front edge flange **35.** When the vertically removable assembly of FIG. **5** is in place, as shown in FIG. **2,** the front edge flange **35** rests sealedly upon the horizontal rear edge **30** of the partial partition **27** while its other edges are supported by cabinet wall angles **36.**

Spacedly above the bottom of the central depressed portion **33** of the divider **31** is located the lower air inlet **38** of the centrifugal blower **25,** whose sheet metal scroll **39** extends horizontally to a scroll outlet **40** through bracket **64** referred to hereinafter, immediately forward of and communicating with the cooled air outlet opening **15** at the rear wall **14.** Above and opposite the lower end inlet **38** the scroll **39** has an upper air inlet **41.** The inlets **38, 41** are circular and concentric with a vertical axis *p* of the lift-out assembly, of which the centrifugal blower **25** is a part. Its blower wheel **42** is of the type divided into two parts by the support plate **43** whose outer edge supports its blades. Air may enter through the upper air inlet **41** to that part of the wheel **42** above the blade support plate **43;** and likewise air may enter through the central depressed divider portion **33** to the lower air inlet **38;** this maximizes the blower capacity.

The condenser compartment **21** is located below the previously-described elements which define the partition at the bottom of the evaporator compartment **20,** namely, the fixed partial partition **27** (which includes the drip pan **28**) and the upper removable divider **31.** In its lower forward portion the condenser compartment **21** has a condenser air inlet; this may be a simple flanged opening **45** in the forward portion of the bottom wall **46** of the cabinet. It provides an upward inflow of air to a condenser coil **48** which is mounted sloping downwardly and aft, with its upper portion presented immediately beneath the perforated forward portion **29** of the drip pan **28.** Accordingly, condensate from the evaporator coil **23** will drip from the pan **28** through the perforated portion **29** directly onto the warm condenser coil **48.** This evaporates the condensate and aids in cooling the condenser coil **48** more advantageously than conventional arrangements.

In order to direct all the condenser air through the coil **48,** a lower central structural member **49** is provided at the rear of the opening **45.** Behind it and somewhat raised is a structural rear lower condenser compartment wall **50,** best seen in the plan view FIG. **6.** At its center, aligned on an axis to correspond with the axis *p* of the lift-out unit heretofore referred to, is a large circular, downward presented condenser air outlet opening **51.**

Beneath the rear lower wall **50** of the condenser compartment **21** and aft of the member **49** is a third compartment whose upper wall is the wall **50** through which the opening **51** leads. This third compartment, designated the air outlet compartment **22,** is bounded below by the bottom cabinet wall **46,** and at its sides by a curving scroll-like discharge deflector wall **52** by which discharged air is deflected sideward.

Mounted in the condenser compartment **21** on its rear lower wall **50** at both sides of the air outlet **51** are a pair of conventional motor-compressors **54,** shown in the plan view FIG **6.** Conventional controls for the motor-compressors **54** are contained in a pull-out drawer **55,** seen in FIG. **2** and **6;** and shown pulled open in FiG **6;** after the removal of the lift-out assembly; when so opened the controls therein are accessible from above.

Referring back to FiG. **5,** the lift-out assembly there shown, generally designated **60,** is built about a motor **61.** It is understood that the refrigeration components described, including the two motor-compressors **54,** the motor **61** of the lift-out assembly **60** and the controls in the drawer **55,** are supplemented by and interconnected operably through conventional means. The shaft of the motor **61** is oriented vertically on the axis *p* and had an upward-extending portion **62** and a downward-extending portion **63.** The motor **61** and other elements of the assembly **60** are mounted on a vertically-extending rear sheet metal support **64** having outer flanges to be fitted between joggled support strips **67** affixed to the rear cabinet wall **14.** This permits vertically downward installation and upward removal of the lift-out assembly **60.** The upper part of the bracket **64** mounts the blower scroll **39** and is cut out to provide the scroll outlet **40.** The upper divider **31,** mounted below the scroll **39,** has a substantially sealed opening through which passes the upward motor shaft portion

62. The lowermost portion of the bracket 64 mounts an assembly support ring or baffle 65 having central air discharge opening 66 beneath which rotates the upper annular portion 68 of a discharge blower 69. This discharge blower 69, whose diameter is smaller than that of the opening 51, is preferably an impeller of the paddle wheel-type; air passes downwardly through its annular portion 68 and outward through its blades, to be deflected in a sideward direction by the discharge deflector wall 52.

Mounted to the upper portion of the scroll 39 of the blower is a handle 70. After connections are made to the motor 61 in the conventional manner, and the other air conditioner components described are connected and supplemented as is conventional, the assembly shown in FIG. 5 is lowered into the rear part of the cabinet until the baffle 65 rests and seals on the margin of the air outlet 51, being then supported in part by the rear bottom wall 50 of the condenser compartment 21. In this position, the upper divider 31 will substantially fill the opening aft of the horizontal rear edge 30, sealing the evaporator compartment from the condenser compartment. The front edge flange 35 of the divider 31 then rests on the horizontal rear edge 30 of the forward fixed partial partition 27; while at its sides and rear the divider 31 rests on the cabinet wall angles 36.

The cabinet arrangement results in air flow patterns of exceptional efficiency, as seen in FiG. 1. First as to the condenser air, it is drawn by the discharge blower 69 upward from the ventilated space beneath the floor system *d*, *e*. Entering through the bottom opening 45 and passing through the condenser coil 48, it passes rearward and thence down through the central opening 66 of the support ring 65, around the downward shaft portion 63 and through the blower 69 into the outlet compartment 22. It is thence discharged sideward below the floor system *d*, *e*, by the blower 69 acting in cooperation with the deflector wall 52. This condenser air flow pattern permits the vertical adjustment of the air conditioner unit through the range (*k*–*m*), while avoiding return flow of the sidewardly discharged condenser air to its inlet opening 45.

Likewise the pattern of air flow through the upper evaporator compartment 20 is efficient and advantageous. Entering through the front grill 12 and passing through the aft-tilted evaporator coil 23, it is drawn into both the upper and lower inlets 41, 38 of the centrifugal blower 25, to be discharged rearwardly into the distributor duct *j*. This generally front-to-rear air flow pattern through the evaporator compartment 20 above the floor system *d*, *e*, somewhat parallels the flow of the condenser air below the floor system.

For servicing after installation, removal of the top wall 17 and lifting out the assembly of FIG. 5 permits easy replacement of the motor 61 should this be necessary. After its removal the controls in the pull-out drawer 55 are accessible by opening the drawer aft as shown in phantom in the plan view FIG. 6. Thus the removable lift-out assembly provides exceptional ease of servicing even those components located below the floor system.

By the unique arrangement of the cabinet into the succession of compartments described, the present air conditioner may be installed downwardly for maximum interior space or upwardly for greater ground clearance. Thus, it is suitable for use in floor systems of any enclosed space, such as that of a trailer, mobile home, field office, etc., where space ventilated by outside air is provided beneath the floor. Accordingly the principles of this disclosure may be adapted by persons having ordinary skill in the art to a variety of uses and modifications.

I claim:

1. An air conditioner adapted for through-floor installation, comprising

a cabinet and conventional air-conditioner components therein operatively connected to each other, the cabinet having

and upper evaporator compartment including an air inlet and a cooling air outlet, whereby to provide a path for air to be cooled and housing along said path the evaporator coil and refrigerated air blower of said components,

partition means to provide a bottom of said evaporator compartment and of said air path,

a condenser compartment immediately therebelow including an upward condenser air inlet and a downward outlet, both spacedly below the evaporator air inlet and outlet,

whereby such spacing permits through-floor installation with the evaporator air inlet and outlet above such floor and the condenser air inlet and outlet and blower means associated therewith therebelow,

the condenser compartment housing a condenser coil of said components proximately beneath said partition and in the path of air flow from said upward inlet to said downward outlet,

said partition having perforations through it immediately above said condenser coil,

whereby to catch the condensate from the evaporator coil and permit it to drip directly onto the condenser coil.

2. An air conditioner as defined in claim 1,

the air outlet of the condenser compartment being a lower surface thereof, the cabinet further having

a third compartment beneath said surface and having an upper wall opening aligned and communicating with said condenser compartment air outlet,

the blower means associated therewith being positioned in said third compartment.

3. An air conditioner as defined in claim 1, wherein

the cabinet top wall is imperforate,

the refrigerated air outlet from the evaporator compartment is in a vertical wall of the cabinet,

the air blower in said evaporator compartment is of the centrifugal type and has a scroll leading horizonally to said outlet, and

the scroll has an inlet spacedly below said cabinet top wall.

4. An air conditioner adapted for through-floor installation, comprising

a cabinet and otherwise conventional air-conditioner components therein operatively connected to each other, the cabinet having

an upper evaporator compartment including an air inlet and a cooling air outlet, and housing the evaporator and refrigerated air blower of said components,

a partition defining a portion of the bottom of such evaporator compartment,

a condenser compartment therebelow including condenser air inlet means to provide upflow of air entering therein and a downward-presented outlet,

the condenser compartment housing a condenser coil, motor and compressor means,

the cabinet further having, beneath said downward-presented outlet of the condenser compartment,

a lateral air outlet compartment having a sideward air outlet and an upper wall inlet opening in common with the air outlet of the condenser compartment,

the motor having a downward shaft extension through said common opening, and

an impeller of the sideward discharge type mounted thereon and housed in said air outlet compartment,

whereby to avoid return flow into the condenser air opening of the air so impelled sideward.

5. An air conditioner adapted for through-floor installation, comprising

a cabinet having

a removable top wall,

an upper evaporator compartment having a room air inlet and a refrigerated air outlet, the compartment terminating downwardly in an upper partial partition having a horizontal edge by which an upper opening is in part defined,

a condenser compartment therebeneath whose lower surface is in part provided by a lower partial partition having a downward outlet opening, and

an air discharge compartment located therebeneath,

conventional evaporator components fixedly positioned in said evaporator compartment and conventional compressor and condenser components fixedly positioned in said condenser compartment and means operatably connecting them, together with

a vertically removable assembly which when in place extends through said upper and lower openings into all three said compartments, including

a motor in the condenser compartment having its shaft oriented vertically and having upward- and downward-extending shaft portions,

its upward-extending shaft portion having a substantially imperforate divider at the level of said upper partial partition, and having a blower assembly thereabove,

whereby the divider substantially fills the upper opening and seals the evaporator compartment from the condenser compartment and the blower assembly thereabove directs air in the evaporator compartment to its outlet,

said downward-extending shaft portion having thereon a discharge blower positioned in the air discharge compartment,

whereby to draw air downward from the condenser compartment to and discharge it from the discharge compartment,

and means to permit such removable assembly to be removed upwardly when the cabinet top wall is removed,

whereby to facilitate servicing.

6. An air conditioner as defined in claim **5**, wherein said discharge blower is of the type which receives air centrally and discharges it outwardly, and wherein said vertically removable assembly further includes ring-like baffle means, positioned about the downward extension of the motor shaft above the discharge blower, to seal against the downward outlet opening of said condenser compartment and conduct air centrally to said discharge blower.

7. An air conditioner as defined in claim **5**, wherein means is provided beneath the upper partial partition to accommodate conventional air conditioner controls and connectors and to provide access to them past said upper partition edge when said assembly is removed.

* * * * *