Sept. 20, 1960 W. H. MULLIN 2,952,997

AIR CONDITIONING APPARATUS

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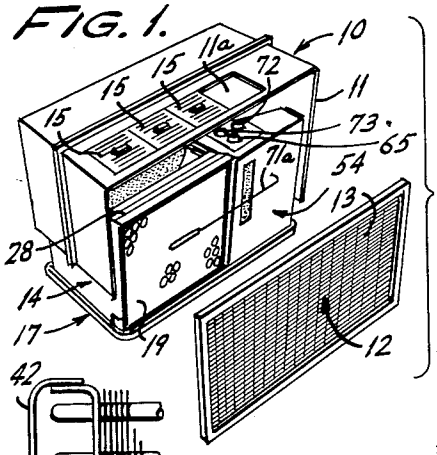
FIG. 1.



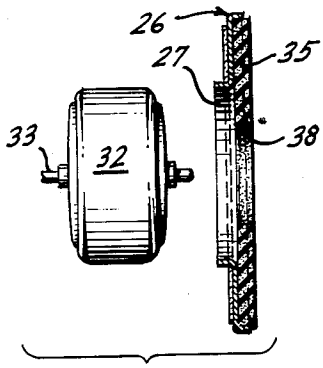


FIG. 5.

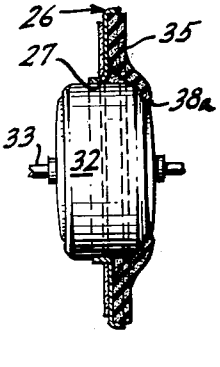


FIG. 6.

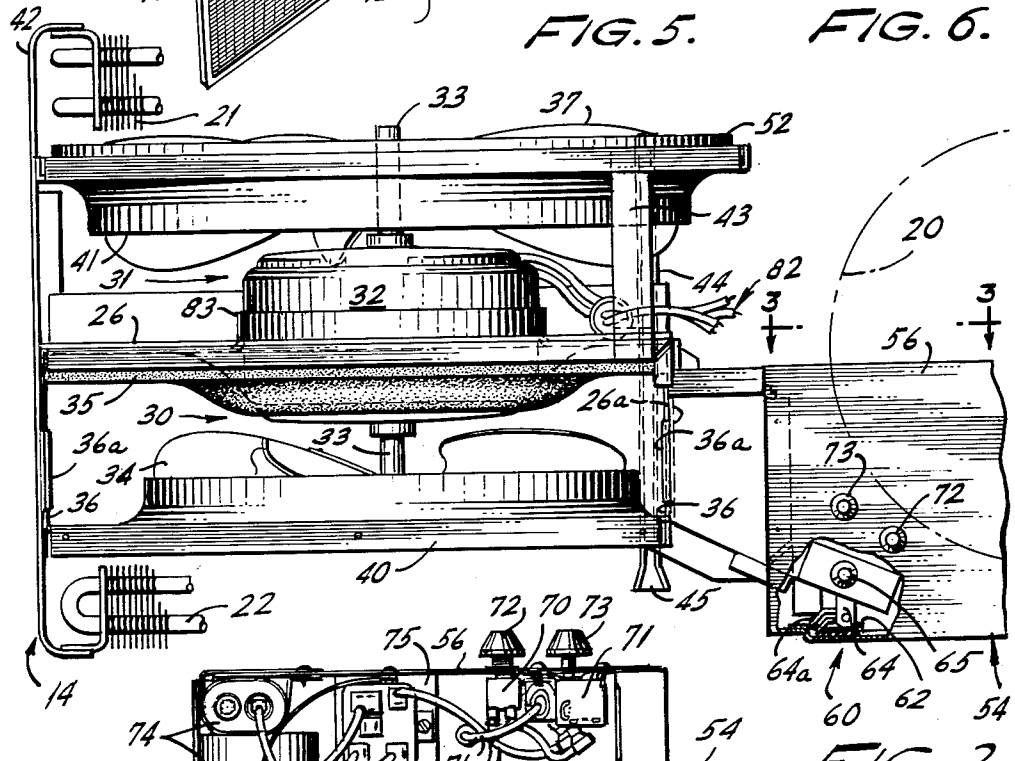


FIG. 2.

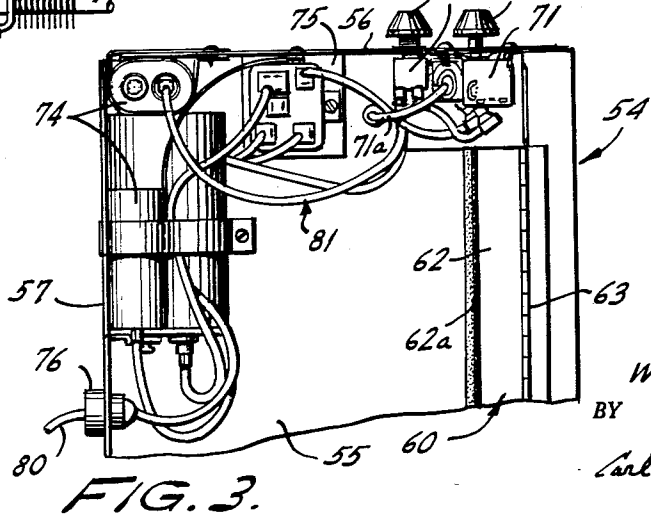


FIG. 3.

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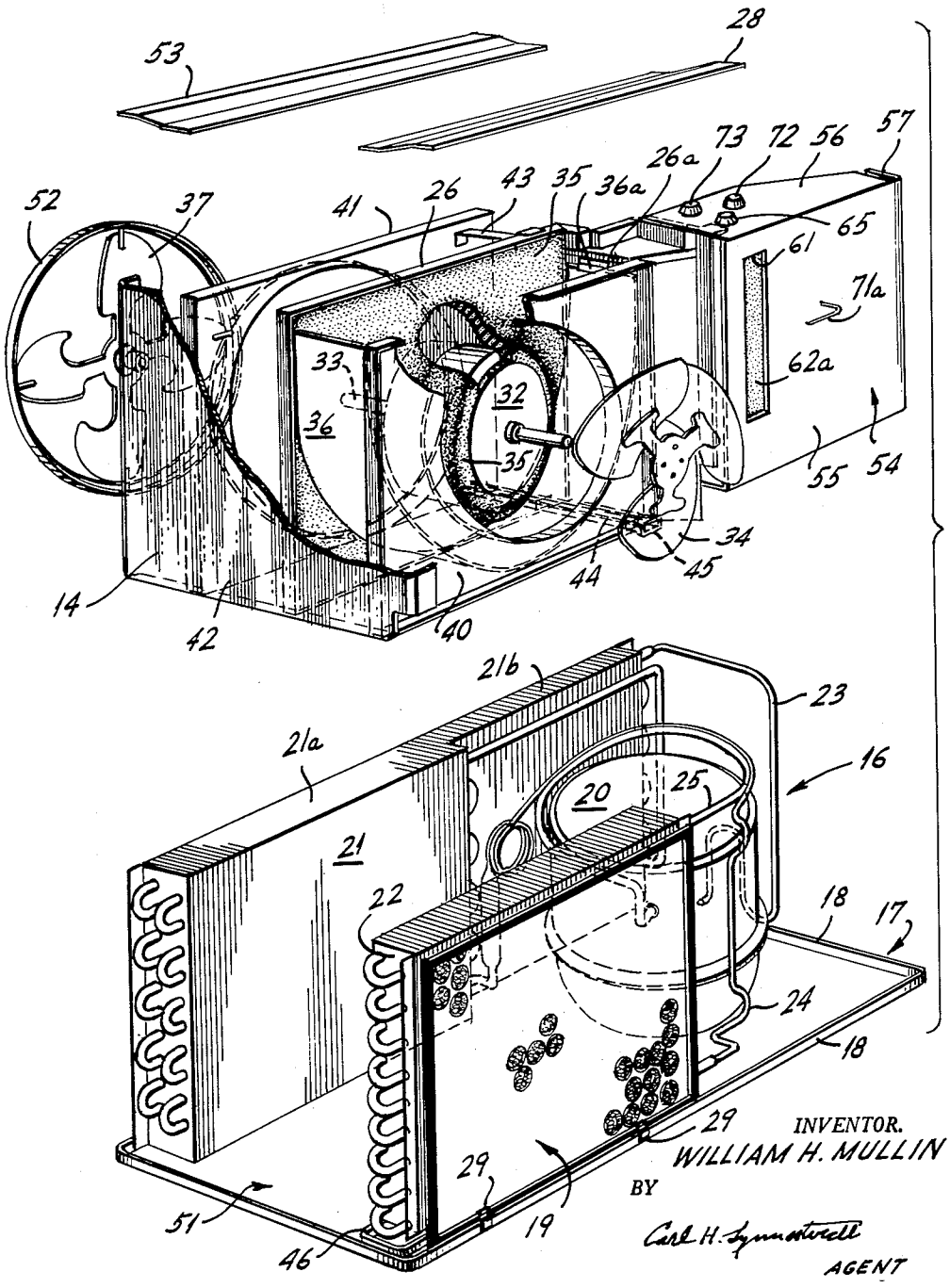
FIG. 4.



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AIR CONDITIONING APPARATUS

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7 Claims. (Cl. 62—409)

The present invention relates to refrigerating apparatus. More particularly, this invention has to do with air conditioning apparatus of a compact and unitary type, and to a novel method of assembling such apparatus.

In air conditioners, and particularly in apparatus of the type commonly referred to as "single room coolers," it is of substantial importance that the overall dimensions of the apparatus or unit be as small as possible. Achievement of this end has presented problems of considerable complexity, especially in view of the relatively large capacity which is desired in present day units of this kind. Basically, the refrigeration circuit employed in such units is well known, and the measure of public acceptance accorded apparatus of this type depends to a substantial degree on reducing its overall dimensions to the smallest possible compass; it being important, however, that such reduction be accomplished without sacrifice of either capacity or flexibility of operation.

It is therefore the primary object of this invention to provide a room cooling unit which is unusually small and compact.

It is another object of the present invention to provide, for an air conditioner, novel compact air moving apparatus of unitary structure.

Another object of the invention is to provide an improved method of assembling air conditioning apparatus.

It is still another object of this invention to provide suitable heat exchange apparatus in novel combination with the aforesaid air handling apparatus.

A further object of the present invention is to include, in a unitary assembly, both mechanical and electrical control components for the air moving and cooling elements of an air conditioner.

To the foregoing general ends, the invention contemplates, in a preferred embodiment thereof, the provision of refrigerating or air conditioning apparatus of the type including evaporator and condenser elements, or "coils," and unitary means for forceably circulating air in heat exchange relation with said coils, and in which the coils and the means for forceably circulating air have such novel arrangement as to minimize overall dimensions of the unit while maintaining optimum operating characteristics of the apparatus. There is further provided novel unitary control panel and air directing means including manually operable means for controlling the operating components of the air conditioning apparatus.

It is an important feature of the present invention that the construction and arrangement of the various components, hereinafter to be more fully described, promote, in addition to compactness of structure, simplicity of manufacture and ease of assembly.

The manner in which the foregoing, as well as other objects and advantages, are realized will be understood from a consideration of the accompanying drawings forming a part of this disclosure, and in which:

Figure 1 is an exploded perspective view of an air conditioner made in accordance with the present invention;

Figure 2 is a fragmentary plan view, on an enlarged scale, of apparatus illustrated in Figure 1;

Figure 3 is an elevational showing of apparatus as viewed in the direction indicated by line 3—3 of Figure 2;

Figure 4 is an exploded perspective view, on an enlarged scale, illustrating the manner of effecting sub-assembly of apparatus partially illustrated in Figure 1; and

Figures 5 and 6 are somewhat diagrammatic showings of the manner of assembling apparatus best seen in Figures 2 and 4.

Now making more detailed reference to the drawings, and particularly to Figure 1, the window mounted air conditioner **10** includes a cabinet **11** and a conventional decorative panel **12**, the latter comprising, in the embodiment illustrated, the inlet air passage **13** for the air moving means **14**. The outlet air passages or grilles **15** disposed in the upper surface of the cabinet **11** are in air flow communication with the novel, unitary air moving means **14**, to be hereinafter more fully described. The aforementioned inlet **13** and outlet air passage **15** are further disposed in air flow communication with a separately handleable, unitary refrigerating means **16** (see Figure 4). Also an aperture **11***a* is provided to accommodate registry therewith of manually operable control means **65**, **72**, **73**, to be hereinafter more fully described.

More particularly, apparatus seen in Figure 4 comprises refrigerating means **16** supported upon a base pan **17** provided with vertically extending peripheral flanges **18**, said means including a motor compressor **20**, a condenser **21**, an evaporator **22**, and associated conduits through the agency of which said compressor, condenser and evaporator are coupled in series flow circuit. These conduits include a discharge line **23**, through which compressed refrigerant is delivered to the condenser **21**, and a feed line **24**, which as shown may advantageously comprise a continuously open restricted connection through which liquid refrigerant is fed to the evaporator for expansion therein. Additionally, there is provided a suction conduit **25** to return the volatilized refrigerant to the compressor. In accordance with the present invention, condenser **21** comprises a multiple-row tube portion **21***a* and a single-row tube portion **21***b*; the advantages of this novel configuration will be hereinafter fully explained.

In accordance with the present invention, and as best seen in Figures 2 and 4, the aforesaid air moving means **14** is a unitary structure comprising a substantially L-shaped partition **26**, **26***a* (Figures 2 and 4) extending, respectively, longitudinally of and transverse the apparatus, the two partitions separating the evaporator coil **22** and its air moving means **30** from the condenser coil **21**, the compressor **20**, and the air moving means **31** associated therewith. A motor **32** is disposed in the partition means and extends through the latter, into both the condensing and evaporating chambers. The motor is provided with a shaft **33** extending into each of the evaporating and condensing chambers, and one end of the shaft supports an axial flow evaporator fan comprising blading **34** adapted to draw air to be cooled inwardly over the coil **22** adjacent thereto and further to discharge the air drawn through the coil in a radial direction with respect to the fan. Radial deflection of the moving air in the aforesaid evaporator chamber with respect to the fan **34** is advantageously promoted by a flexible and resilient sheet **35** of insulating material such as foam rubber, or the like, extending across the exposed end of the motor **32** and the partition means **26** thereby providing an air deflecting contour. Preferably, sheet **35** has an aperture **38** disposed in registry with the end of motor **32** whereby a portion of the motor is in heat exchange relation with relatively cool air in the evaporating chamber; thus, cooling of the motor is accommo-

dated. A commercially available material found suitable for use as the combined insulating and air deflecting sheet **35** is foam polyurethane. An arcuately formed air baffle **36** (Figure 4) is disposed in substantially axial alignment with fan **34** and adjacent lower portions thereof, and insures substantially unidirectional flow of the cooled air upwardly through grilles **15**. Baffle **36** is preferably a flexible, fluid-impervious sheet-like member, and is held in place by virtue of its inherent resilience and its cooperation with suitably formed tabs **36***a*. Thus, the nature of the baffle mounting contributes to ease of sub-assembly of the air moving means as well as the overall compactness of the unit. By thus providing discharge of air from the upper horizontal wall of the housing the full vertical wall portion opposite the fan is available advantageously to accommodate extension of cooling coil **22** substantially the full height of the front wall (see Figure 1).

A fan **37** is carried by the other end of shaft **33**, and its construction and arrangement is such that it draws air inwardly over the double-tube portion **21***a* of condenser coil **21** adjacent thereto and discharges this same air over the compressor **20** and through the single-tube portion **21***b* of the condenser **21** adjacent the latter; also, portion **21***a* of the condenser coil is further characterized in that it has a greater fin depth than does portion **21***b*. It will be appreciated that any undue heat absorbed by motor **32** in the condensing compartment will advantageously be dissipated to the cooler air of the evaporating chamber through the motor end exposed through aperture **38** in insulating sheet **35**. The foregoing novel pattern of air flow and condenser construction advantageously provides apparatus which is both compact and capable of operating at optimum efficiency in that relatively cool outside air is drawn first over the portion **21***a* of the condenser having the greater fin depth, and comprising the major portion of its overall heat exchange surface; this air is then forced over the compressor, followed by moving the resultant relatively warm air over the portion **21***b* of the condenser having the lesser fin depth, and comprising the lesser portion of its total heat exchange surface. Also, the offset configuration of portion **21***a* accommodates positioning of the compressor thereby contributing further to compactness of the unit.

Additional structure of the unitary air moving means **14** includes fan shrouds **40** and **41**, and an end wall **42** provides spacing of the shrouds **40** and **41** from the partition means **26**, the spacing being further ensured by upper and lower bracket means **43** and **44**, respectively. The lower bracket means advantageously comprises a sloping upwardly presented channel having its upper end **45** adapted to receive condensate from the evaporator coil drip pan **46** (see Figure 4) for gravity flow down the channel to a disposal sump area **51** in the base pan **17**.

A conventional slinger ring **52** is provided on fan **37** disposed in the condenser chamber, said ring being so constructed and arranged as to dip into condensate accumulated in the area **51** and cause the latter to impinge upon baffle means **53** disposed above condenser coil portion **21***a* and adapted to deflect the water downwardly upon the relatively warm condenser for evaporation therefrom.

Referring to Figures 1 to 4, the unitary control panel **54** extends substantially parallel to partition means **26**, and along an edge portion **18** of the base pan, in substantial alignment with the outer surface portion of the cooling coil **22**. Panel **54** comprises a vertical wall portion **55**, and an upper horizontal wall portion **56** extending therefrom. A fresh air damper means **60** is provided in the panel, and provides selective air flow communication between the outside air, by way of the compressor compartment, and the air conditioned area. Damper means **60** comprises an aperture **61** in the vertical wall **55** and a damper **62**, to close the aperture, hingedly mounted, as seen at **63**, upon the aforesaid vertical wall portion. Sealing of the damper **62** against the edges defining aperture **61** is accommodated by a sheet of sponge-like material **62***a*, for example foam polyurethane, affixed to the damper and over-lapping the latter to provide the seal. Additionally, the damper means includes a linkage **64**, **64***a* operable by a knob **65** affixed to a vertically extending shaft (not shown), the latter being suitably journalled in the horizontal wall portion **56**. Also carried by the horizontal wall portion of the panel are a power supply switch **70**, and a thermostat **71**, each having manually operable knobs **72** and **73**, respectively, disposed adjacent the damper control knob **65**. Thus, manual controls for the electrical and mechanical operating components are provided in a unitary structure. Non-adjustable electrical components carried by the vertical wall portion **55** of the panel include fan and compressor motor condensers designated generally by the numeral **74**, as well as the starting relay mechanism **75** for the compressor motor. Service cord **80** for the air conditioner is also affixed to wall portion **57** of panel **54**, by known suitable means, as seen at **76**. Inasmuch as the electrical circuitry of air conditioning apparatus of the type illustrated is well known in the art, no detailed description thereof will be undertaken other than to point out that the novel assembly includes suitable wiring harness elements utilizing quick disconnect solderless terminals, and designated generally by the numerals **81** and **82**.

In accordance with certain novel method concepts of the present invention, and as best seen in Figures 5 and 6, a method of contouring the insulating sheet **35** is illustrated. Referring first to Figure 5, the aforesaid sheet of insulating material **35** is affixed to the partition means **26**. Partition **26** has an aperture **27** so configured as to receive the motor **32** for substantial registry therewith (see Figure 6). The insulating sheet **35** has an aperture **38** somewhat smaller in diameter than the aperture **27**, and in particular accordance with the present invention the motor **32** is inserted into the aperture **27** a distance sufficient to cause the insulating material **35** to stretch, and enlarge aperture **38** to the position generally designated at **38***a* in Figure 6, thereby contouring the insulating sheet. The motor is then clamped in place by known suitable means designated generally by the numeral **83** in Figure 2.

Referring again to Figures 1 and 4, conventional air filter means **19** of known construction is disposed between air inlet grille **12** and evaporator **22**, and is held in place by tabs **29**. As best seen in Figure 1, control feeler bulb **71***a* extends through wall **55** of control panel **54** and across filter **19** where it is disposed in the inlet air stream. Also, suitable cover plate means **28** overlies evaporator **22**, and prevents lateral escape of air from the evaporator in an upward direction.

In order to provide a more complete understanding of the present invention, the manner of assembly of the apparatus will be more fully described. Refrigerating unit **16** (see Figure 4) is, of course, assembled in accordance with known practices in which a base pan **17** is provided having a drip tray **46** disposed thereon, and unit **16** is then mounted upon the base, by known suitable holding means (not shown), and in such position that the evaporator **22** nests within the tray **46**. Thus is provided the basic unit upon which all other components are assembled.

Prior to final assembly, sub-assembly of the air moving means **14** involves attaching partition **26** and shrouds **40**, **41** to the wall portion **42**, followed by attaching brackets **43** along with combined bracket and drain trough **44**. Insulating sheet **35** is then attached to the partition **26** followed by insertion of air deflector **36** in the manner hereinafter described, to mount the same. The motor **32** is then assembled into the air handling means **14**, in the

manner previously described and illustrated in Figures 5 and 6. Sub-assembly of the air handling means is completed by mounting fans 34 and 37 upon the ends of shaft 33.

As regards sub-assembly of the unitary control panel 54, the components hereinbefore described are attached to this panel by known suitable holding means, and the necessary electrical connections are provided for attachment of such components to the compressor and fan motors.

The next component to be mounted upon the base pan 17 comprises the novel air handling apparatus 14, its mounting being accomplished by lowering it into position and then attaching the end wall 42 to base pan 17. Installation of the control panel 54 then follows, after which cover plates or baffles 53 and 28 are attached. As seen in Figure 1, the cabinet 11 is then attached to the base pan 17. The filter 19 is then placed in its position and the control feeler bulb 71*a* extended across the same, followed, finally, by attaching the grille 12 by known suitable means (not shown), to cabinet 11.

From the foregoing description it will now be understood that the novel apparatus and method of assembling the same results in substantial reduction in the overall dimensions of the apparatus, and in significant simplification of both manufacturing and service procedures. Simplification of the latter is particularly advantageous where hermetically sealed systems are concerned, since such systems are not ordinarily provided with service shut-off valves.

While the principles of this invention should not be considered as limited in applicability to apparatus of any particular dimensions, it is of interest that practise of the invention has made it possible to reduce the size of air conditioning equipment to about one half the cubic volume of conventional units of equivalent capacity.

I claim:

1. In air conditioning apparatus of the type including evaporator means adapted for air flow therethrough, air moving means for discharging air being drawn through the evaporator means laterally with respect to the latter and in heat exchange relation to portions of the air moving means, said last mentioned means comprising: partition means spaced from said evaporator means, said partition means having an aperture provided therein, a motor disposed in said aperture and including a shaft extending transverse said partition means; axial-flow fan means carried by said motor shaft and disposed intermediate said evaporator means and said partition means; and a flexible and resilient sheet-like member having an aperture normally smaller than the portion of the motor extending through the partition means, said sheet-like member, in the region of said aperture, being flexed over the motor whereby a portion of the motor is exposed through the aperture provided in said member and portions of the sheet surrounding the aperture are deflected by such flexing to extend arcuately from the motor and onto the partition means, the construction and arrangement of said fan means and said deflected sheet-like member being such that air is drawn through the evaporator means by the fan means toward the partition means, including exposed portions of the motor, and deflected laterally from the fan by the formed sheet-like member.

2. In air conditioning apparatus of the type including means defining a housing, upstanding partition means within said first mentioned means dividing the same into evaporator and condenser chambers, an evaporator element within said evaporator chamber, a compressor element and a condenser element within said condenser chamber, and air propelling means for directing cooling air in heat exchange relation with said condenser element and air to be cooled in heat exchange relation with said evaporator element, said last mentioned means comprising: a motor provided with a shaft, said motor extending through said partition means into each said chamber and said shaft being provided with axial-flow fan means disposed in each said chamber, and a flexible and resilient sheet-like member of low thermal conductivity disposed in said evaporator chamber and stretched across said motor onto said partition means, the construction and arrangement of said fan, evaporator, and sheet-like member being such that air is drawn across said evaporator by the fan in axial flow relation thereto and deflected radially therefrom by said sheet-like member.

3. A compact air conditioner including a box-like housing having top, bottom and end wall portions, open oppositely disposed side wall areas, and apertures in said top wall portion; a condenser disposed in one of the mentioned side wall areas and extending substantially the full height and width of the latter, said condenser having a zone of greater depth and another zone of lesser depth; an evaporator and adjacent panel means disposed in the other of the mentioned side wall areas and extending substantially the full height and width thereof, said panel means being disposed opposite the mentioned condenser zone of lesser depth and said evaporator coil being disposed opposite the mentioned condenser zone of greater depth; a compressor disposed intermediate said panel means and said condenser; refrigerant conduit means interconnecting said condenser, evaporator and compressor; and partition means separating said condenser and compressor from said evaporator and including air moving means disposed intermediate said evaporator and said condenser for moving air to be cooled inwardly through the evaporator and discharging the same upwardly through the apertures in the housing top wall portion, while moving air inwardly over the condenser zone of greater depth, thence over the compressor and outwardly through the condenser zone of lesser depth.

4. Apparatus in accordance with claim 3, and further characterized in that said panel means disposed in the other of the mentioned side wall areas includes a horizontal wall portion extending from said side wall area and disposed in substantial registry with one of the said apertures in said top wall portion of the housing, said panel means further having an aperture, a pivotally mounted damper overlying said aperture for opening and closing movements relative to the latter, and manually operable control means disposed in the horizontal wall portion of said panel means and extending through the aperture provided in the top of the said top wall portion of the housing, said control means being arranged to operate said damper.

5. A compact air conditioner including a housing having top, bottom and end wall portions, open side wall areas, and apertures in said top wall portion; a condenser disposed in one of the mentioned side wall areas and extending substantially the full height and width of the latter, said condenser having a zone of greater depth and another zone of lesser depth; an evaporator disposed in the other of the mentioned side wall areas and extending substantially the full height and width thereof, said evaporator being disposed opposite the mentioned condenser zone of greater depth; a compressor disposed adjacent the mentioned condenser zone of lesser depth; refrigerant conduit means interconnecting said condenser, evaporator and compressor; and partition means separating said condenser and compressor from said evaporator and including air moving means disposed intermediate said evaporator and said condenser for moving air to be cooled through said evaporator and said apertures in the housing top wall portion, while moving air inwardly over the condenser zone of greater depth thence over the compressor and outwardly through the condenser zone of lesser depth.

6. An air conditioner made in accordance with claim 5, wherein said air moving means comprises an axial-flow fan, a fan motor including a shaft mounting said fan adjacent said evaporator and a housing extending through said partition means, a sheet of flexible and resilient ma-

terial extending across said partition means and stretched onto said motor housing, said material being so contoured by said housing as to provide radial air discharge from said fan, and deflector means for effecting substantially unidirectional flow of the radially discharged air through said apertures in the top wall, said deflector means including an arcuate member extending away from said partition means, and disposed substantially in the plane of said fan, said member further being substantially coaxial with said motor shaft and having its open side presented toward the air discharge apertures.

7. Apparatus for moving air, comprising: partition means; motor means including a housing portion extending away from said partition means; axial flow fan means carried by said motor means and disposed adjacent its housing portion; a sheet of flexible and resilient material extending across said partition means and stretched onto the housing portion of said motor means, said material being so contoured by the motor means housing portion as to promote radial air discharge from said axial flow fan means; and means for effecting substantially unidirectional flow of the radially discharged air including an arcuate member extending away from said partition means and disposed generally in the plane of said fan means, said arcuate member being substantially coaxial with the said fan means.

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