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Davison

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[54] **COMBINATION AIR HEATING AND COOLING APPARATUS FOR LIMITED SPACE INSTALLATIONS**

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[52] **U.S. Cl.** **165/48,** 165/122

[51] **Int. Cl.** **F25b 29/00**

[58] **Field of Search** 165/48, 97, 122

[56] **References Cited**

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[57] **ABSTRACT**

A combination air heating and cooling apparatus suitable for use in installations where space is limited, having a conditioning chamber containing both a heating unit and a cooling unit, a blower which is rotatable alternatively to one of two limiting or rest positions, an air distributor assembly, and valve means cooperating therewith, the structure in one position being arranged to direct air downwardly over the heating unit and through a downwardly directed plenum, while bypassing the cooling unit; and in the other position to direct air upwardly across said cooling unit, while bypassing the heating unit, and to direct the air thus cooled for being discharged upwardly from the apparatus.

10 Claims, 5 Drawing Figures

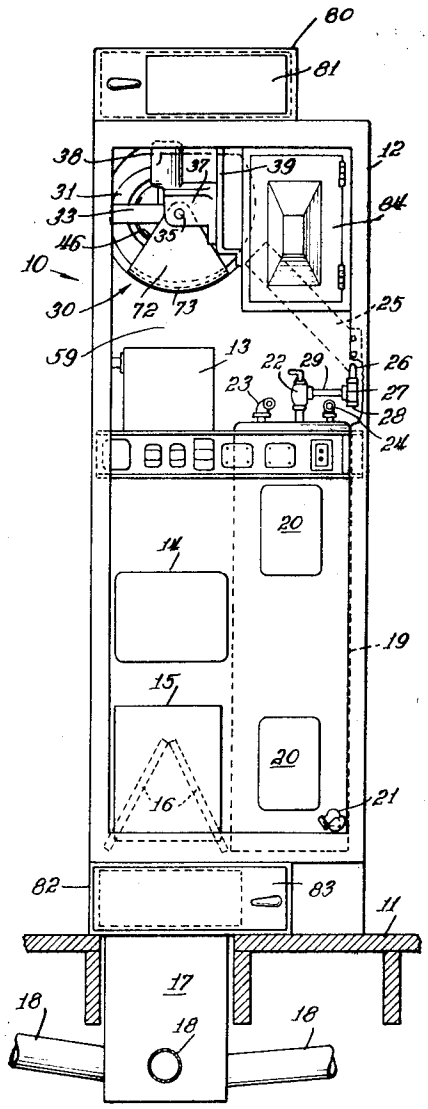

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Fig. 1

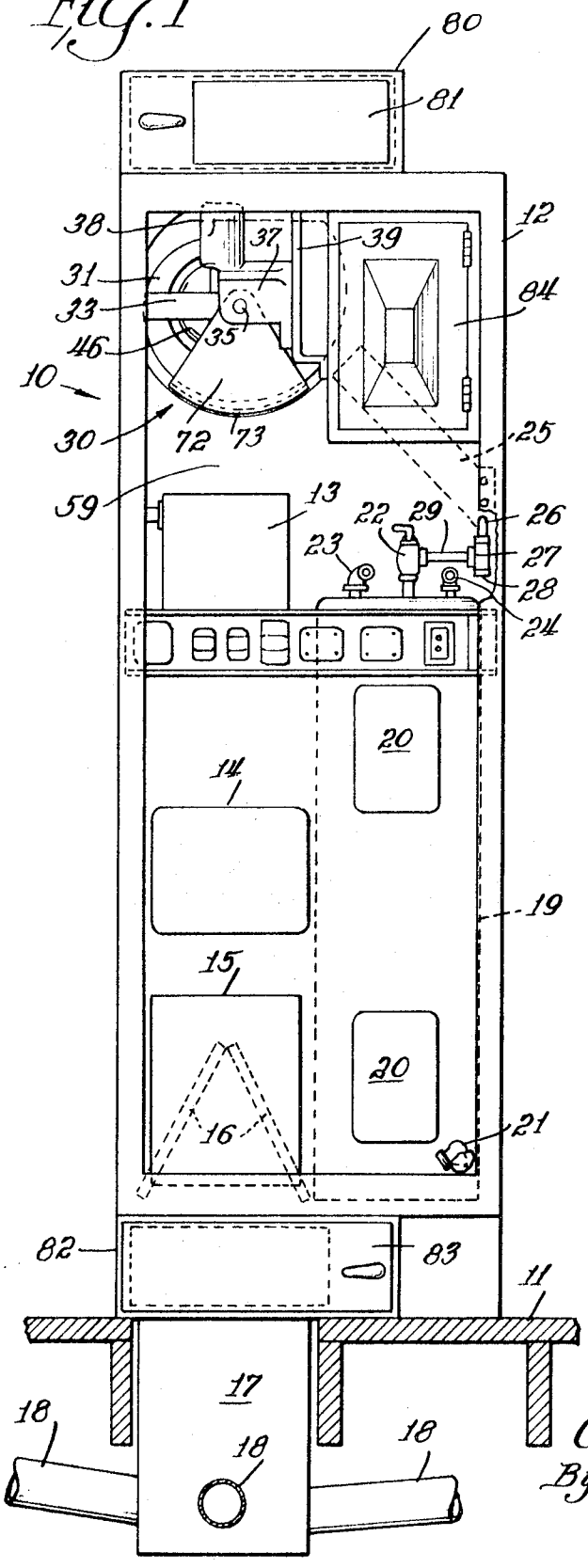

Fig. 2

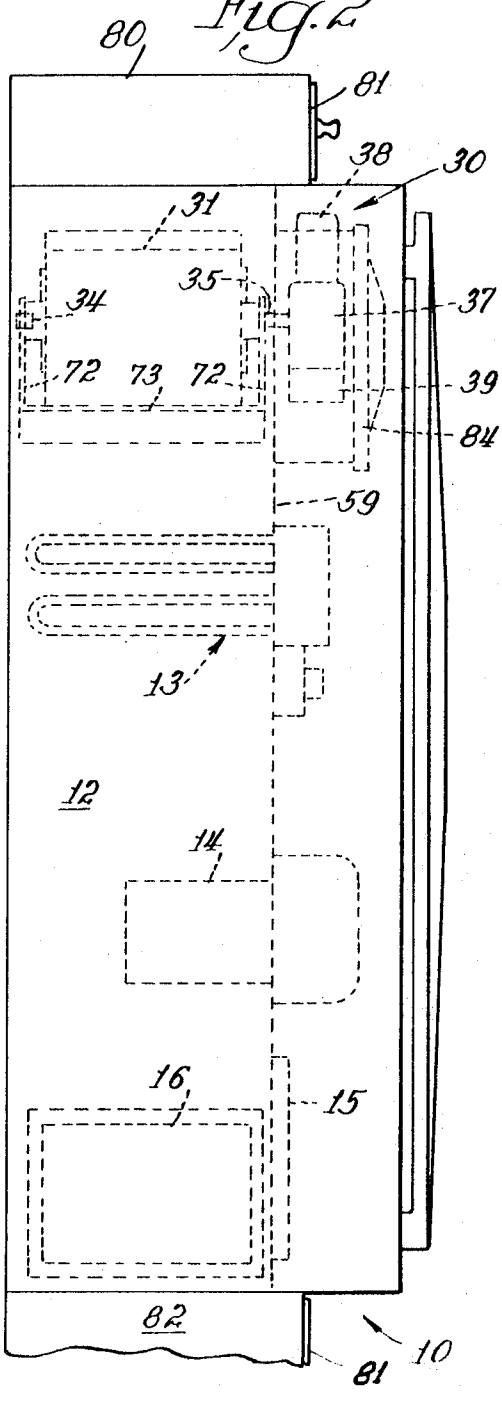

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Fig. 3

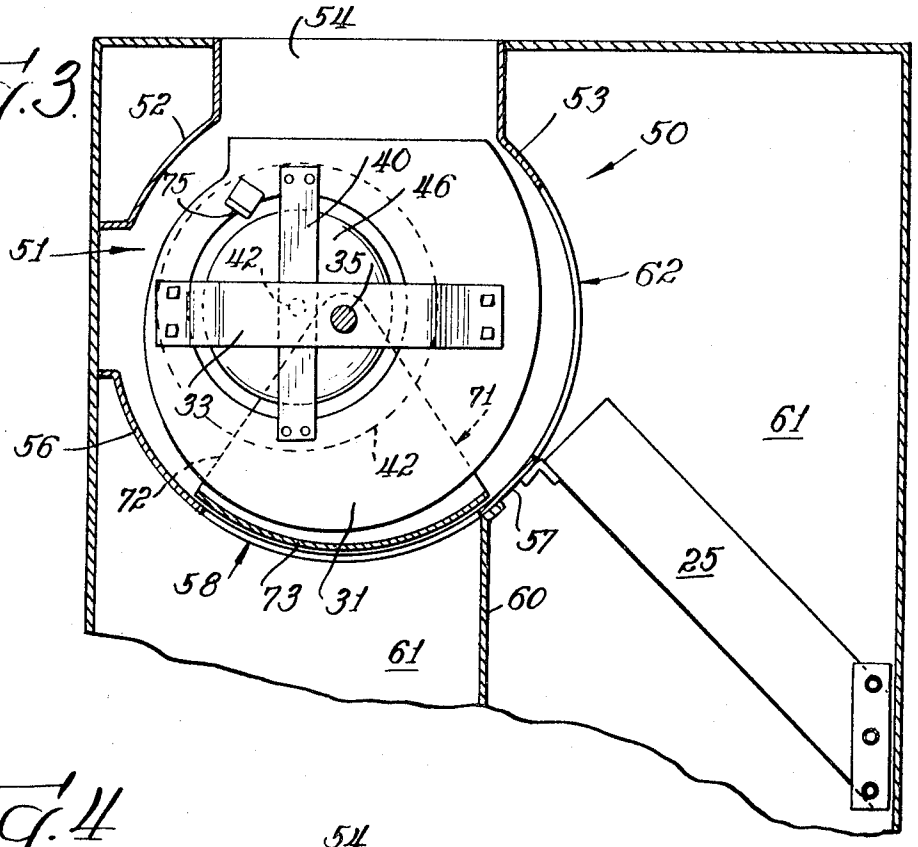
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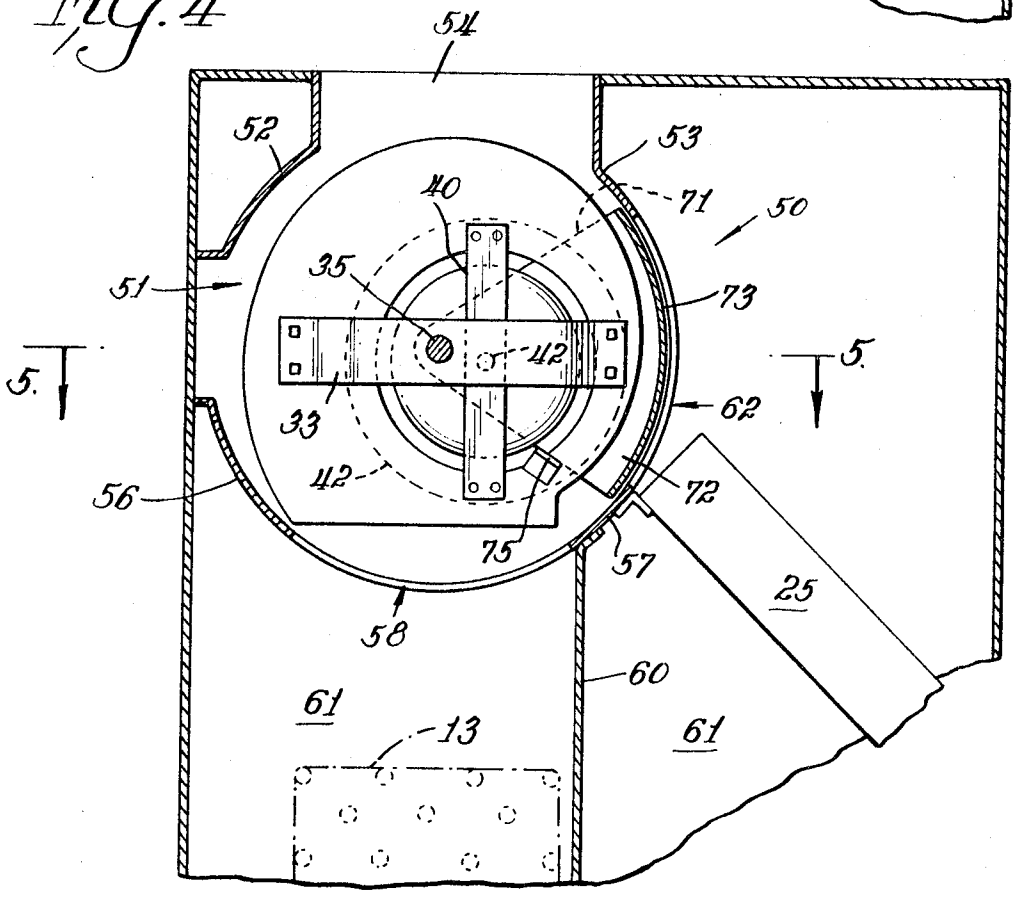
Fig. 4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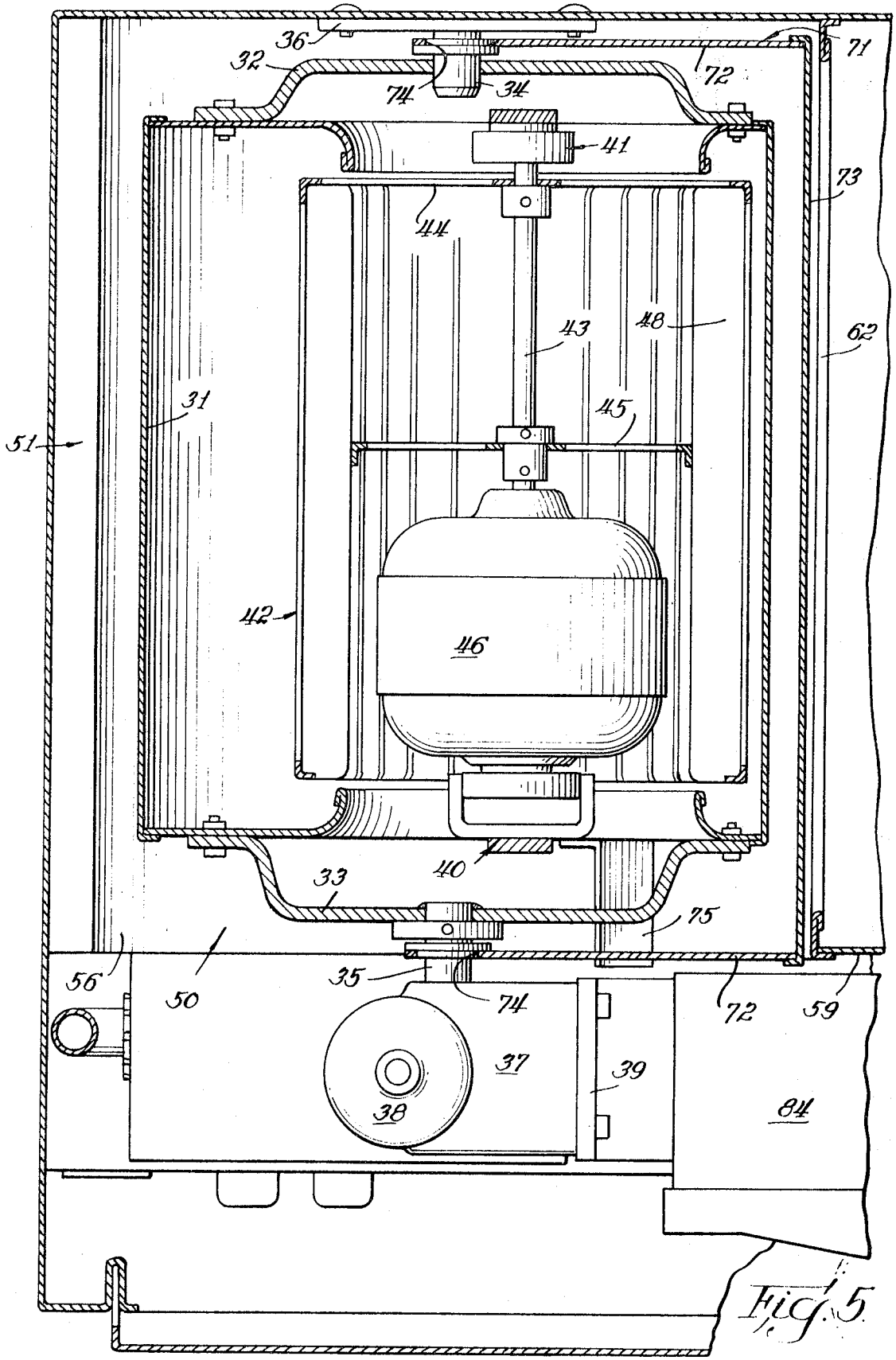
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FIG. 5

COMBINATION AIR HEATING AND COOLING APPARATUS FOR LIMITED SPACE INSTALLATIONS

BACKGROUND OF THE INVENTION

The present invention relates to improved heating and air conditioning equipment arranged in a unitary enclosure, and is more particularly concerned with such equipment which is compact and particularly adapted for use in small dwellings such as house trailers, modular homes, small ranch homes, and other such dwellings or other structures where space is at a premium.

Central air conditioning for use in the home has become extremely popular in recent years. It is generally used in combination with existing furnaces. Where space is ample, as for example in a large basement, separate heating and air conditioning units may be utilized. However, with the advent of smaller dwelling places such as modular homes, trailer homes, and small ranch homes, where space is at a premium, there is a present-day need for compactness. To meet this need, combined heating and cooling apparatus mounted in a single unit have been developed in the art. Such units combine heating, cooling, and even hot water heaters, humidifiers and main electrical panels, all in one unit prewired and assembled for quick and easy installation. However, existing units are not as compact nor as efficient as might be desired.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a combined heating and air conditioning apparatus which is extremely compact and is suitable for use in small dwellings such as trailers, modular homes, or small ranch homes.

It is still further an object to provide an apparatus of the type described which is extremely efficient in both heating and cooling modes.

It is an additional object to provide an apparatus of the type described which releases hot air at the perimeter of each room at the floor level, and which releases cooled air at the ceiling level along the interior walls of each room.

It is still an additional object to provide an apparatus of the type described which is so arranged that the cool air upflow bypasses the heating coils of the heating unit and the heated air downflow bypasses the cooling coils of the cooling unit, thereby eliminating dust particles from plugging or burning on the cooling fins, thereby eliminating regular removal of cooling coils for boiling out to clean and necessary recharging of the system, and damp air from rusting and corroding the heat coils.

It is still further an object to provide a unit of the type described contained in a cabinet which, though compact, has sufficient space therein to house, in addition to the heating and cooling units, a hot water unit, a humidifier, a filter, and a main electrical panel, the entire unit being prewired and assembled for quick and easy installation by unskilled labor in the dwelling structure in which it is to be used and for ready attachment to the main power source.

It is still an additional object to provide a unit of the type described which is relatively inexpensive to build and to operate.

Still further objects and advantages of the invention will appear as the description proceeds.

According to the invention a combined heating and cooling apparatus is provided having a blower which is rotatably reversible, so that hot air may be forced downwardly, and, alternatively, cold air upwardly, and having an air flow distributor and valve means cooperating therewith which so directs the air flow that the cold air substantially bypasses the heating coils and the hot air substantially bypasses the cooling coils, thereby preventing undue corrosion and burning on of foreign matter on the heating and cooling units.

To the accomplishment of the foregoing and related ends, the invention, then, consists of the useful apparatus herein fully described and particularly pointed out in the claims, the annexed drawings and the following description setting forth in detail an illustrative embodiment of the invention, such disclosed embodiment illustrating, however, but one of the various ways in which the principle of the invention may be used.

BRIEF DESCRIPTION OF THE DRAWINGS

In the annexed drawings:

FIG. 1 is a front elevational view of a modular unit containing the novel reversible blower and air distributor of the present invention.

FIG. 2 is a side elevational view of the apparatus shown in FIG. 1.

FIG. 3 is a fragmentary view partially in cross-section showing the blower and air distributor in cooling position.

FIG. 4 is a fragmentary view partially in cross-section showing the blower and distributor in the heating position; and

FIG. 5 is a cross-sectional view taken at the line 5—5 of FIG. 4.

DESCRIPTION OF THE SPECIFIC EMBODIMENT

Referring to FIGS. 1 and 2, the modular unit 10 of the invention is shown supported on a floor 11 and mounted within a sheet metal cabinet 12. Additionally contained within the cabinet 12 are a heat unit 13 which may be operated by electricity, gas, oil, or hot water, and a humidifier 14. An access door 15 is mounted on the cabinet in front of air filters 16. A plenum 17 is mounted below the unit, extending through the floor, and having ducts 18 connected thereto, the ducts being connected at their other ends to registers (not shown). A hot water tank 19 is mounted within the cabinet 12, and provided with access doors 20. The hot water tank is provided with a tank drain having a hose connection 21, a pop-out valve 22, water inlet 23, and water outlet 24. A cooling unit or coil 25 (FIGS. 1, 3 and 4) is mounted in an upper portion of the modular unit 10 and is provided with a condensation drain 26, and a T-joint 27 having an open end 28 going to the drain. A connection 29 is provided as a drain from the hot water tank 19.

The reversible blower assembly 30 of the invention is shown in greater detail in FIGS. 3, 4 and 5. The assembly 30 is provided with a blower housing or scroll 31 supported by brackets 32 and 33 affixed to the ends thereof. The unit pivots about a pair of pivot pins 34 and 35. The pivot pin 34 is affixed at one end to a plate 36 (FIG. 5), and is journaled through an aperture in the bracket 32. The pivot pin 35 is affixed at one end to the bracket 33, and at the other end is connected to the shaft of a gear speed reducer 37 powered by a motor 38. The blower assembly 30 is so constructed that the

entire structure pivots about the pivot pins **34** and **35**, when the motor **38** is actuated. The gear reducer and motor are mounted by means of a bracket **39**. Limiting switches (not shown) are provided to stop the motor when the open end of the blower housing **31** points upwardly, placing the blower in position for forcing cooled air upwardly, or alternatively when the open end is in the downward position, placing the blower in position for forcing hot air downwardly.

Referring to FIG. **5**, the blower assembly **30** is shown in detail and comprises a motor **46** mounted on motor supports **40** and **41**. A cage **42** is mounted on the motor shaft **43** by means of brackets **44** and **45**.

An air distributor assembly **50** is mounted in the cabinet **12** and includes a cylindrical distributor chamber **51**. The distributor chamber **51** is defined by several structures. The upper portion is formed by partially arcuate walls **52** and **53** having their ends extending upwardly to form a top port **54**. The lower portion of the chamber is defined by arcuate flanges **56** and **57** defining a hot air port **58** therebetween in the vicinity of the heating unit. The distributor chamber **51** is further defined by the side wall and rear wall of the cabinet **12**, and a front wall **59** (FIG. **2**). A bracket **60** supports the arcuate flange **57**. A conditioning chamber **61** is provided and is defined by the flanges **53** and **57**, the top, side wall and rear wall of the cabinet **12**, and the front wall **59**. A cold air port **62** is defined by flanges **53** and **57**, the rear wall of the cabinet **12**, and the front wall **59**. The conditioning chamber **61** communicates with the distributor chamber **51** through the hot air port **58** and through the cold air port **62**. The heating unit **13** is positioned within the conditioning chamber **61** adjacent the hot air port **58**, and the cooling unit **26** is positioned within the conditioning chamber **61** adjacent the cold air port **62**.

The structure **60** may alternatively be in the form of a partition partially separating the conditioning chamber **61** into hot air and cold air portions connected at the bottom of the chamber.

The distributor assembly **50** is provided with a distributor valve **71** comprising a pair of parallel spaced-apart lateral vanes **72** in the form of circular sectors connected to an arcuate peripheral vane **73** (FIG. **5**). The lateral vanes **72** are provided with apertures **74** having the pivot pins **34** and **35** journaled therethrough and are free to pivot on the pins. A valve actuating arm **75** (FIGS. **3** and **4**) is affixed to the blower housing **31** and is adapted to engage the distributor valve **71** and rotate it after 90° of lost motion has been encountered by the valve **71** to a position 90° removed from its rest position determined by gravity. Alternatively, other means known in the art such as direct driven movements such as gears, belts or separate motors or solenoids may be used to operate the valve **71**.

In addition to the various optional units which may be installed in the cabinet **12** as described above, such optional units as air filters may also be installed. As shown in FIGS. **1** and **2**, at the upper portion of the cabinet **12**, an air filter case **80** is provided housing an electronic air filter **81**, and at the bottom of the case an additional air filter case **82** is provided housing an electronic air filter **83**. Alternatively, a single air filter may be utilized, placing it in the upper case **80** during the air cooling cycle and removing and replacing it in the air filter case **82** when the warming cycle is used. Additionally, an electrical service entrance box **84** is shown mounted in the cabinet.

In operation, when the unit of the present invention is set for the heating mode, an electrical switch is actuated which supplies current to the reversing motor **38**, thereby rotating the blower assembly counterclockwise until it reaches its limiting position shown in FIG. **4** in which the open end of the blower is directed downwardly. As the blower assembly rotates from the position shown in FIG. **3** toward the position shown in FIG. **4**, the blower assembly rotates through an angle of 90° while the valve **71** remains stationary in the position shown in FIG. **3**. At the end of the 90° rotation, the valve actuating arm **75** engages the edge of the valve **71** and causes it to rotate with the blower assembly through an angle of 90° until the position shown in FIG. **4** is attained. In this position the cold air port **62** is closed by the arcuate peripheral vane **73** and the hot air port **58** is opened. The circulation now is from the top port **54** into the blower assembly, and out through the hot air port **58** and into the heating zone of the chamber **61** housing the heating unit **13**. While bypassing the cooling coils, because of the closed cold air port **62** the hot air is then forced through the plenum **17** and into the ducts **18** where it is distributed to the various room heating register (not shown).

When the air conditioning or cooling mode is desired to be operated, the proper switch is actuated which causes the motor **38** to operate in reverse direction and to rotate the blower assembly clockwise toward the position of FIG. **3**. The valve **71** is supported on the valve actuating arm **75** and follows the blower assembly until the valve reaches the vertical position where it covers the hot air port **58**. It is retained there by gravity as the blower continues to the limiting position shown in FIG. **3**. In this position, air is drawn in through the registers, through the ducts **18**, through the plenum **17**, into the cold air portion of the chamber **61**, through the bank of cooling coils of cooling unit **25**, through the cold air port **62**, through the blower housing **31**, and through the top port **54**, where the cold air encounters and is deflected by the ceiling and distributed laterally throughout the dwelling, eventually descending to the floor where the air is returned through the registers, ducts **18**, plenum **17**, and recycled through the cooling coils. Because the hot air port is closed, the cooled air goes directly into the distributor chamber **51**, bypassing the heating unit.

The present invention utilizing a rotatable blower assembly, air distributor and valve assembly has many advantages. As can be seen in FIG. **3**, when the apparatus is in the cooling mode, air passes through the conditioning chamber **61**, through the cooling coils **25**, the cold air port **62** and the top duct **54**, thereby bypassing the heating coils **13**. Consequently, during the summer the heating coils are not corroded by debris or corrosive materials which might be present in the air and which subsequently could be burned onto the heating coils. Moreover, the cooled air which is heavier than the surrounding air is directed upwardly toward the ceiling and is distributed as the air descends to the floor. When the apparatus is placed in the heating mode, the air is drawn in through the top port **54** into the blower where it is forced downwardly, as shown in FIG. **4**, through the hot air port **58**, into the heating portion of conditioning chamber **61**, through the heating elements of the heating unit **13**, through the plenum

17, ducts 18, and through the registers into the various rooms. Since the cold air port 62 is closed by the distributor valve 71, the air circulation substantially bypasses the cooling coil-containing portion of chamber 61 so that the cooling coil unit 25 is completely bypassed. Consequently, the cooling unit remains free of lint, burned particles, and corrosion which it otherwise would acquire. Since the heating and cooling coils are kept clean, the heat exchange efficiency of the units is much greater.

The apparatus of the invention has many other advantages. Because a single rotatable blower is utilized, the cost and space requirements of a second blower are avoided. The arrangement whereby cold air is discharged upwardly and hot air downwardly results in much more efficient circulation and mixing of the air in each mode of operation. Additionally, because the unit is so compact and convervative of space, various optional functional units may be incorporated into the small space of the cabinet, such as humidifiers, filters, water heaters, and electrical service boxes. The apparatus is, moreover, relatively inexpensive to produce and easy to assemble. Moreover, the apparatus may be constructed of standard easily available parts and materials. The entire unit including various optional units is packaged in a single case which may be quickly installed in a small space and quickly set into operation.

Other modes of applying the principle of my invention may be employed, instead of the one explained, change being made as regards the apparatus herein disclosed, provided the structure defined by any of the following claims or the equivalent of such stated structure be employed.

I therefore particularly point out and distinctly claim as my invention:

1. A combination heating and air conditioning apparatus suitable for being mounted in a limited space comprising a housing, means within said housing defining a conditioning chamber having a heating unit mounted in one portion thereof and a cooling unit mounted in another portion thereof spaced apart from said heating unit, a substantially cylindrical air distribution chamber, first port means positioned adjacent said heating unit providing heated air communication between said conditioning chamber and said air distribution chamber, and second port means positioned adjacent said cooling unit providing cooled air communication between said conditioning chamber and said air distribution chamber, blower means having inlet and outlet rotatably mounted in said air distribution chamber about a horizontal axis passing substantially centrally through said blower means, said blower means being rotatable to each of at least two rest positions, one in which said outlet is directed toward said first port, and another in which said outlet is directed away from said first port, and valve means arranged in one position to close said first port and open said second port, and in another position to open said first port and close said second port.

2. A combination heating and air conditioning apparatus according to claim 1, wherein said valve means comprises a pair of spaced-apart sheet-form flanges of circular sector form connected together by a transversely oriented arcuate flange, said valve means being pivotally mounted at the apexes of said spaced-part flanges.

3. A combination heating and air conditioning apparatus according to claim 2, wherein said valve means is mounted within said air distribution chamber and pivots about the same axis as said blower means, said blower means being provided with a valve means-engaging member so arranged that when said blower is in one rest position said valve engaging member is disengaged from said valve and said valve is maintained by gravity in position for closing one port means, and when said blower means rotates to the other rest position, said valve means is engaged and moved to the position where said first port means is opened and where said arcuate flange covers the other port means.

4. A combination heating and air conditioning apparatus according to claim 3, wherein said valve means in its disengaged position covers said first port, and in its engaged position moves to a position where it covers said second port.

5. A combination heating and air conditioning apparatus according to claim 1, wherein an electric motor and gear reduction means in combination are provided for rotating said blower means.

6. A combination heating and air conditioning apparatus suitable for being mounted in a limited space comprising:

A. a housing,

B. means within said housing defining a pair of chambers including:

1. a conditioning chamber having a heating unit mounted in one portion thereof, a cooling unit mounted in another portion thereof spaced apart laterally from said heating unit, and a portion intermediate said heating and cooling units, and

2. a substantially cylindrical air distribution chamber having a first port means positioned adjacent said heating unit providing hot air communication between said conditioning chamber and said air distribution chamber, a second port means positioned adjacent said cooling unit providing cold air communication between said conditioning chamber and said air distribution chamber, and a third port means positioned at the top of said air distribution chamber providing communication between said air distribution chamber and the exterior,

C. blower means having inlet and outlet rotatably mounted in said air distribution chamber about a horizontal axis passing substantially centrally through said blower means, said blower means being rotatable to each of at least two rest positions including a cooling position in which said outlet is directed upwardly toward said third port means, and a heating position in which said blower outlet is directed downwardly toward said first port means; and

D. valve means arranged to close said first port means and to open said second port means when said apparatus is in the cooling condition, and to close said second port means and open said first port means when said apparatus is in the cooling condition.

7. A combination heating and air conditioning apparatus according to claim 6, wherein said valve means comprises a pair of spaced-apart sheet-form flanges of circular sector form connected together by a transversely oriented arcuate flange, said valve means being

pivotally mounted at the apexes of said spaced-apart flanges.

8. A combination heating and air conditioning apparatus according to claim **7**, wherein said valve means is mounted within said air distribution chamber and pivots about the same axis as said blower means, said blower means being provided with a valve means engaging member so arranged that when said blower is in one rest position said valve engaging member is disengaged from said valve and said valve is maintained by gravity in position for closing one port means, and when said blower means rotates to the other rest position, said valve means is engaged and moved to the position where said first port is opened and where said arcuate flange covers the other port means.

9. A combination heating and air conditioning apparatus according to claim **8**, wherein said valve means in its disengaged position covers said first port, and in its engaged position moves to a position where it covers said second port.

10. A combination heating and air conditioning apparatus according to claim **6**, wherein an electric motor and gear reduction means in combination are provided for rotating said blower means from one rest position to the other.

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