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[54] **CONSTANT VOLUME AIR HEATING AND COOLING UNIT**
7 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **165/103,**
98/40, 98/106, 137/601, 165/35
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[50] **Field of Search** 165/101,
103, 35; 137/601; 98/40, 106, 108

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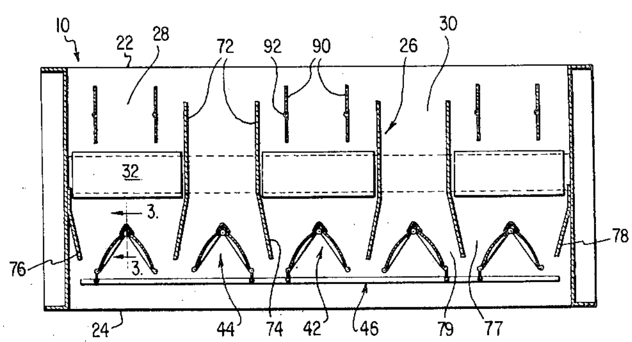
ABSTRACT: An air supply conditioning unit of the constant volume air heating and cooling type is disclosed. Air foil shaped dampers are provided at the outlet ends of the heat exchanger and free air passages to regulate the amount of air passing through each. The unit maintains a constant volume of air flow and efficiently blends the various streams of existing air without causing undue turbulence.



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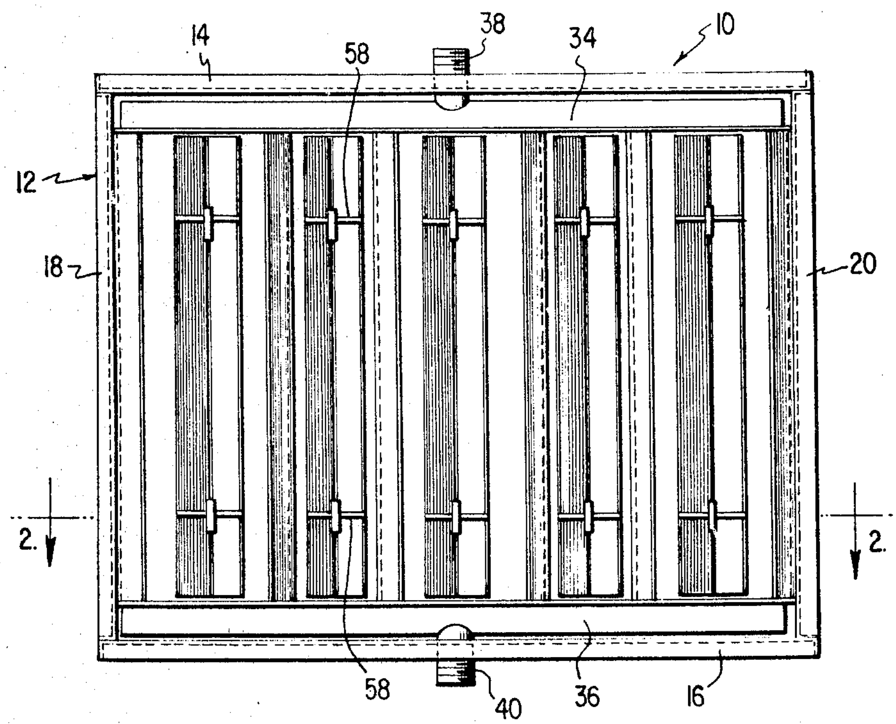

FIG. 1

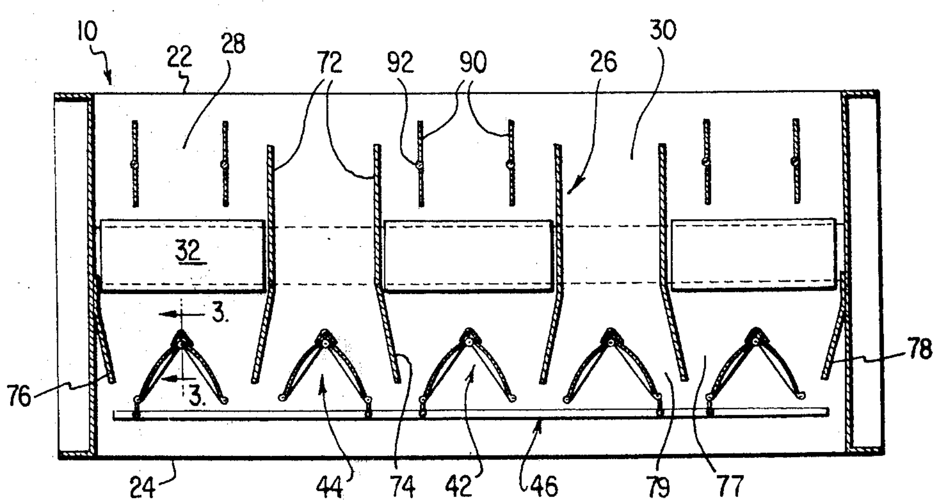

FIG. 2

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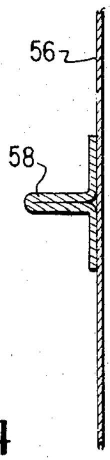

FIG. 4

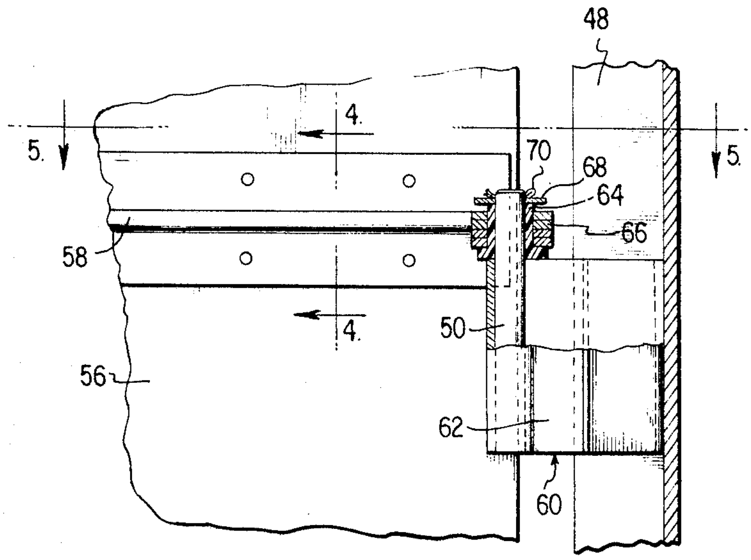

FIG. 3

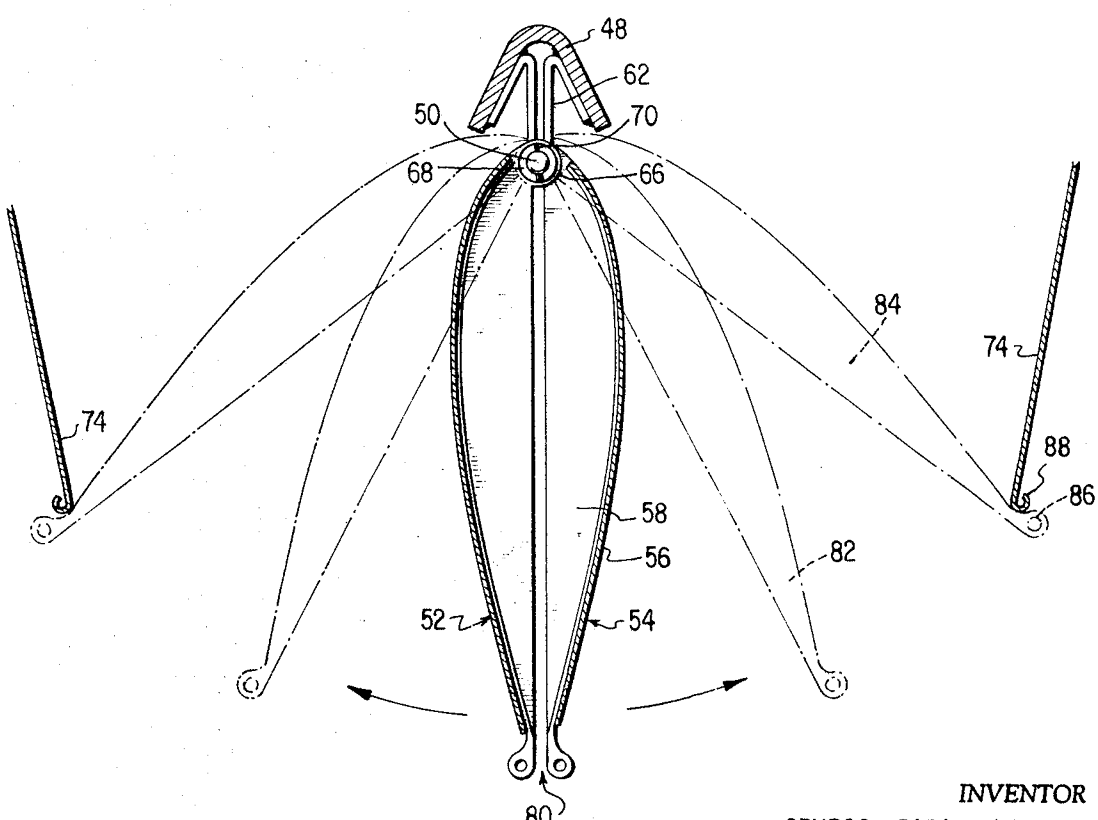

FIG. 5

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CONSTANT VOLUME AIR HEATING AND COOLING UNIT

This invention relates to fresh air supply heating and cooling units. More particularly, this invention relates to a fresh air supply heating and cooling unit of the type which is divided into a plurality of passages, some of said passages containing a heat exchanger and others allowing the free passage of air.

Constant volume air heating and cooling units are well known and find extensive use. A particular feature of these units is their construction wherein they are divided into passages, the alternate ones of which have heat exchange coils, with the remaining passages being free to carry by-pass air. The heat exchange coils can take various forms depending upon whether they are to be used for heating, cooling or both. If used for heating, the coils are preferably steam heated in a conventional manner. Dampers must be provided to direct the incoming air into either the air treating passages or the air by-pass passages, or both in varying proportions, depending upon the inflow and outflow temperatures.

The placement and shape of such dampers has been the subject of numerous engineering problems. Certain units have had dampers of a generally planar configuration located at the inlet end thereof and disposed between the partitions that form the passages. Such units have suffered from the disadvantages of turbulence and air leakage around the dampers even when in the closed position. Another prior art device has movable dampers, each pivoting about a point at one edge of its respective partition and having an arm extending into each adjacent passage. Such a construction results in a possibility of partially or completely opening one passage while partially or completely closing its adjacent passage, the air flow control over each passage being dependent upon two separate dampers. A certain amount of turbulent flow occurs as a result of the construction of the prior art devices. Further, a particular disadvantage is the fact that a constant volume of air flow cannot be maintained at every setting of the dampers. This problem of variation of total air volume is created by variations in air resistance at various damper positions, as well as by the configuration and arrangement of the dampers. Still another difficulty associated with the prior construction has been excessive resistance to air flow at various damper positions due to the damper configuration. Another, major disadvantage is concerned with the immediate blending of air of the two streams into a single air stream of uniform temperature.

It is, therefore, a primary object of the present invention to provide a heating and cooling unit free of the aforementioned and other such disadvantages. Another, important object of the present invention is to provide a unit for heating and cooling air having partitions dividing the casing into alternate heating/cooling and free-flow passages, and dampers located in the passages at the discharge end thereof.

Still another object of the present invention is to provide a unit for heating and cooling air, consistent with the foregoing objects, having dampers of such configuration that minimum turbulence and resistance to air flow is produced.

Still another more specific object of the present invention is to provide a unit for heating and cooling air having a set of dampers at the outlet end thereof, which dampers are of air foil configuration joining in a common pivoting point at the center of the passages, the pivoting point being at the upstream end of the dampers, and having means to oscillate the tail ends of the dampers in opposite directions.

Yet another object of the present invention is to provide a unit for heating and cooling air conforming to the foregoing objects having a set of air foil dampers located in the center of each passage at the discharge end of the unit in such manner that when the dampers oscillate the impact end of the dampers pleats the air into two substantially equal streams while the tail end of the dampers changes the direction of each stream in order to provide immediate mixing of the two adjacent air streams from two passages thus providing a single blended stream and minimizing stratification.

A further important object of the present invention is to provide a unit for heating and cooling air which is relatively inexpensive to manufacture, which is of reliable construction, which will be practical and efficient, and which will accomplish its function with a high degree of reliability and ease of operation.

The invention will be better understood, and objects other than those set forth above will become apparent, when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein:

FIGURE 1 is a front-elevational view of the air treating unit of this invention, as seen from the discharge end thereof;

FIGURE 2 is a cross-sectional view taken on line **2-2** of **FIGURE** 1;

FIGURE 3 is an enlarged side-elevational view, partially broken away and partially in cross-section, of the damper used in the air treating unit of this invention;

FIGURE 4 is a cross-sectional view taken on line **4-4** of **FIGURE** 3; and

FIGURE 5 is a cross-sectional view of the damper of this invention taken on line **5-5** of **FIGURE** 3, and showing several positions of the damper in phantom.

Referring now to the drawings, an air supply conditioning unit generally designated by the numeral **10** is shown in **FIGURE** 1. The unit **10** includes a casing **12** comprising top and bottom panels **14** and **16**, respectively, and side panels **18** and **20**. The upper and lower panels **14** and **16** and the side panels **18** and **20** are bent at both ends to form an inlet flange **22** and an outlet flange **24** as shown in **FIGURE** 2. The unit **10** is partitioned by partitioning panels generally designated by the numeral **26**. Partitioning panels **26** divide the unit **10** into alternate heat exchange passages **28** and free air passages **30**. Heat exchangers **32** are placed in the heat exchanger passages **28** and are connected to a main supply header **34** and a main return header **36**. The main supply header **34** is in turn connected to inlet fitting **38** and, in a like manner, the main return header **36** is connected to an outlet fitting **40**. The heat exchange medium is supplied to supply header **34**, passes through the individual heat exchangers **32**, and leaves the unit through the return header **36**. The air to be conditioned enters the unit at the inlet flange **22**, passes through the free air passages **30** and/or the heat exchanger passages **28**, and leaves the unit at the outlet flange **24**.

In order for the air to be conditioned properly, three basic functions must be accomplished. First, the correct proportion of air must pass through the heat exchanger and such air must be in correct proportion to the air volume which passes through the free air passages so that the temperature of the mixture downstream will be that which is desired. Secondly, the two streams of air, i.e. the stream of air which passes through the heat exchanger passage and that which passes through the free air passages, must mix immediately downstream in order to provide a single blended stream of air with a uniform temperature. Thirdly, the blending of the several streams of air must be accomplished with the least possible resistance to air flow and, additionally, without any substantial variations in air resistance which will create air volume variations. The particular construction of the unit of the present invention efficiently performs these three functions in a manner heretofore unattainable. A set of heat exchanger dampers **42** located downstream of the heat exchanger **32** and substantially on the center of the heat exchanger passage **28** regulates the opening of the heat exchanger passage **28** in a manner that only the correct amount of air is allowed to pass through. Similarly, a set of free-pass dampers **44** located substantially in the center of the free air passages **30** regulates the opening of the free air passages **30**, thus allowing only the correct amount of air to pass therethrough. The heat exchanger dampers **42** and the free-pass dampers **44** are interconnected through linkage **46** in such a manner that when linkage **46** is actuated it causes heat exchanger dampers **42** to open while simultaneously closing free-pass dampers 44, and vice versa, thereby properly proportioning the air between heat exchanger passages 28 and free air passages 30. Linkage 46, which is shown schematically, is actuated in a known manner by pneumatic or electric damper actuator means (not shown) controlled by a thermostat.

Damper assemblies 42 and 44 are similar in construction. The following description of the damper assemblies should, therefore, be taken as applying to either the heat exchanger dampers 42 or the free-pass dampers 44. Attention is now directed to **FIGURES** 3, 4, and 5, wherein it is shown that the damper assembly is supported by damper assembly support 48 and hinged securely on pivoting pins 50. The damper support 48 remains in a fixed position in the center of its passage, whether heat exchanger passage 28 or free air passage 30, and is of such configuration as to receive the impact of air with the least possible resistance, thereby splitting the air stream into two substantially equal streams. This configuration is generally V-shaped in cross-section, with the apex of the V, however, somewhat rounded and pointed upstream of the air flow. Each damper assembly comprises a pair of similar, symmetrical air foil members 52 and 54. Each of the air foil members comprises a flat shaped piece 56 welded to a pair of stiffening webs 58 formed in a T-shaped cross-section and shaped so that the sheet 56 is arranged in air foil configuration. Each damper has a stiffening web 58 located in the upper region thereof and a similar stiffening web 58 located in the lower region thereof as can be seen in **FIGURE** 1. Similar mounting means are used at the upper and lower stiffening locations. The mounting means includes a hinge assembly generally designated by the numberal 60 which has a hinge assembly 62 secured to the damper assembly support 48 by conventional means such as welding. The hinge pin 50 is inserted into plate 62 over which is fitted a bearing 64 fabricated of any suitable bearing material such as nylon. At the upstream end of web 58 is located a fitting 66 which rides on bearing 64. Washer 68 and cotter pin 70 secure the damper onto the hinge assembly.

Returning to **FIGURE** 2, it can be seen that the dividing means 26 include substantially parallel portions 72 at the upstream ends thereof and portions 74 which converge in heat exchanger passages 28, or diverge from free air passages 30. End walls 18 and 20 partially serve as end partitions which are parallel to the partition portions 72. Outlet end portions 76 and 78 which bend toward their respective heat exchanger passages 28 provide the necessary symmetry in the end passages. The heat exchanger passages 28 are somewhat wider than the free air passages 30, with the outlet end portions 76 of the baffles 26 being bent sufficient to provide heat exchanger passage outlet ducts 77 of substantially equal width as free air passage outlet ducts 79. The purpose of the diverging or converging portions 74, 76 and 78 will become apparent from the following dicussion which, while presented in terms of portions 74, should be taken as including portions 76 and 78. As can be seen from **FIGURE** 5, the upstream end of the damper which pivots on pin 50 remains substantially in a constant position while the tail end 80 of the dampers oscillate outwardly and inwardly in order to determine the size of the respective outlet openings and regulate the amount of air flow. The positions of the dampers shown in phantom as 82 and 84 are in the partially open and fully open positions, respectively. When the dampers are in the fully open position as at 84 the tail end 86 mates with the outlet end 88 of partitions 74, thereby providing an effective seal. It becomes clear that oscillation of the dampers not only changes the effective outlet size of the respective passages but also changes the direction of the divided air stream in each of the passages and causes the air stream of adjacent passages to intercept and blend into a single stream of a uniform temperature. On the other hand, when the dampers are in the fully closed position, that is, when they are in juxtaposition in alignment with the apex of the damper support 48 to fully open the respective air passage, the air flows smoothly around the dampers without creating any turbulence and emerges from the fully open passage to blend with the air emerging from the other passages.

It should be noted that the damper supports 48 and dampers 42 and 44 are of such configuration and design that even though they are located in the center of the air streams the resistance to air flow is minimal. Further, the configuration and design of the dampers 42 and 44, the damper supports 48, the damper tail ends 80, their interrelationship with each other, and their relationship to the partitions 26 are such that the smooth air flow with the least possible resistance and without volume variations is accomplished.

In some instances, it is desirable to close off the inlet ends of the heat exchange passages 28 at the same time as the outlet ends thereof are closed. To this end, flood dampers 90 are provided as shown in **FIGURE** 2. The flood dampers 90 pivot about pivot pins 92 located centrally thereof to provide the necessary closing of the inlet ends of the heat exchanger passages 28.

As for the heat exchangers, these may be of any conventional type employing a gaseous or liquid heating or cooling medium or even of the type employing a solid heat exchange medium or an electric element. Furthermore, the heat exchangers can be of the type which either heat or cool depending upon the ambient temperatures.

Thus, it can be seen that the objects set forth at the beginning of this specification have been successfully achieved. Since many embodiments may be made of the instant inventive concepts, and since many modifications may be made of the embodiment hereinbefore described, it is to be understood that all matter herein is to be interpreted merely as illustrative and not in a limiting sense.

I claim:

1. In an air supply conditioning unit, a casing having an inlet and outlet; dividing means within said casing defining a plurality of throughflow passages, each having an inlet and an outlet end; heat exchange means disposed in alternate passages between the ends thereof to form alternate heat exchange passages and free air passages; damper means disposed in each of said passages at the outlet end thereof, said damper means comprising a pair of similar symmetrical airfoil members pivoting in opposite directions about an axis disposed substantially on the central axis of said passage; and means for activating said damper means such that the damper means in said heat exchange passages move in an opposite direction from the damper means in said free air passages.

2. An air supply conditioning unit as defined in Claim 1, wherein said dividing means comprises a plurality of baffles each having an inlet end portion and an outlet end portion, each inlet end portion being disposed substantially parallel to the flow of air and said outlet end portion being offset from said direction of air flow such that said outlet end portion partially restricts the flow of air at said outlet end of said heat exchange passages and provides a mating surface for said damper means in adjacent heat exchange and free air passages.

3. An air supply conditioning unit as defined in Claim 2, wherein said heat exchange passages are wider than said free air passages and said outlet end portions of said baffles on either side of said heat exchange passages converge toward each other a sufficient amount to provide heat exchange passage outlets and free air passage outlets of equal width.

4. An air supply conditioning unit as defined in Claim 1, further comprising a pair of secondary dampers disposed in said heat exchange passages at the inlet end thereof and means for activating said secondary dampers to close the same when said damper means at said outlet ends of said heat exchange passages are closed.

5. An air supply conditioning unit as defined in Claim 1, wherein said damper means is supported at its upstream end on a substantially V-shaped damper support.

6. An air supply conditioning unit as defined in Claim 1, wherein said air foil members each comprise a flat air foil shaped piece secured to a pair of stiffening webs.

7. An air supply conditioning unit as defined in Claim 1, wherein the tail end of each of said air foil members has a mating surface which corresponds with a mating surface at the

discharge ends of the respective dividing means to thereby close off the corresponding passages.