Dec. 9, 1969 J. W. SPRADLING 3,482,504

AIR CONDITIONING TERMINAL CONTROL UNIT WITH ACOUSTICAL BAFFLE

Filed March 22, 1967 2 Sheets-Sheet 1

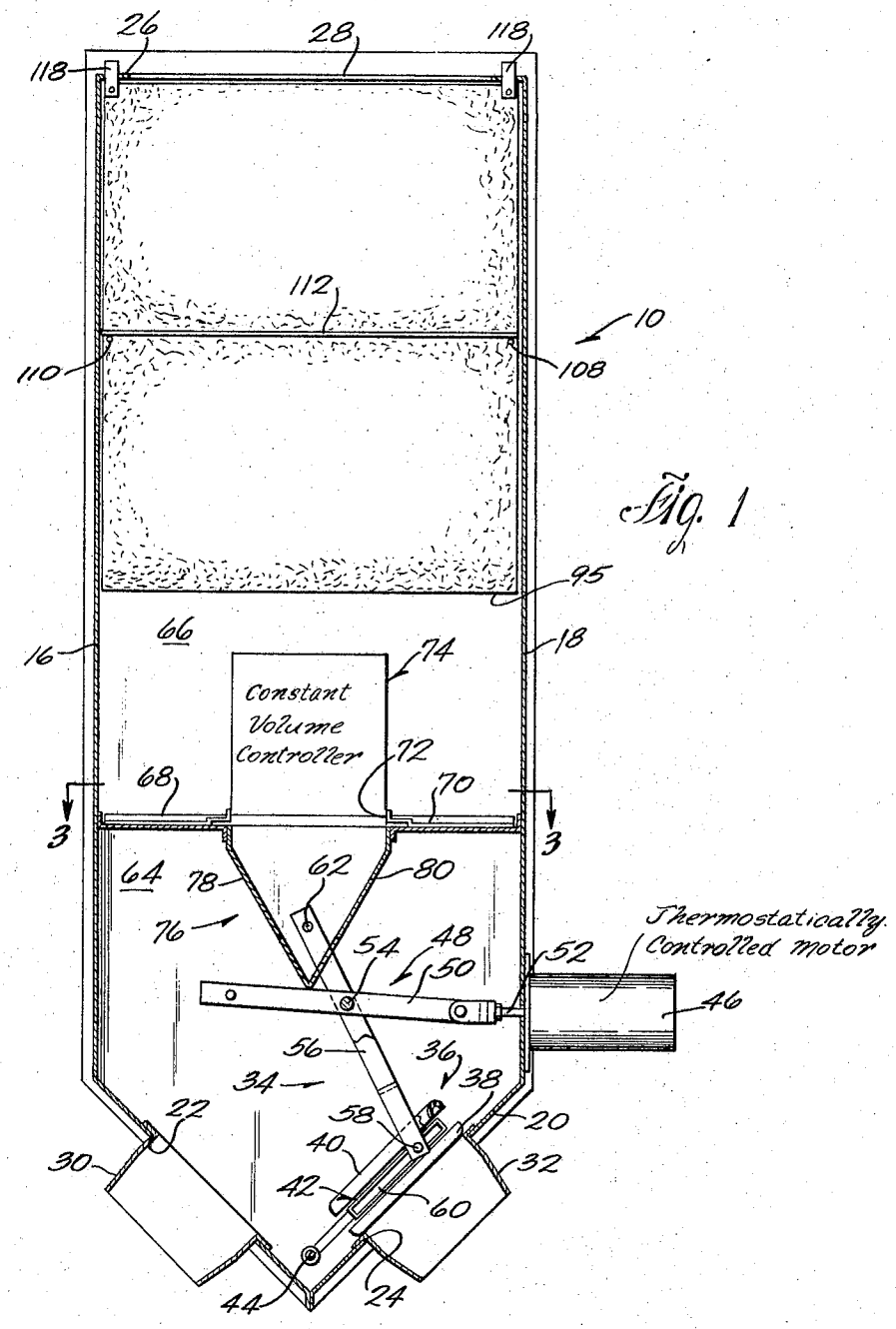


Fig. 1

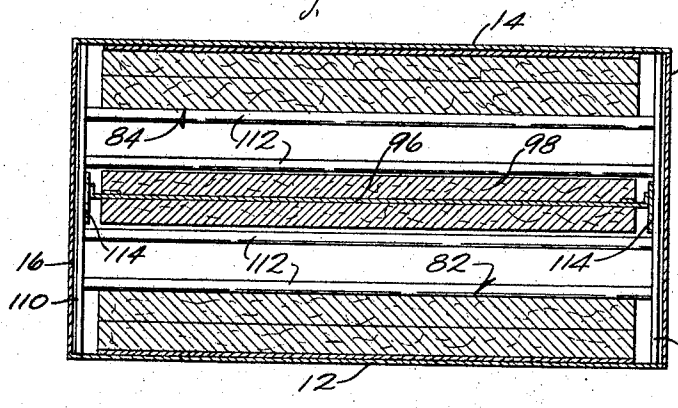
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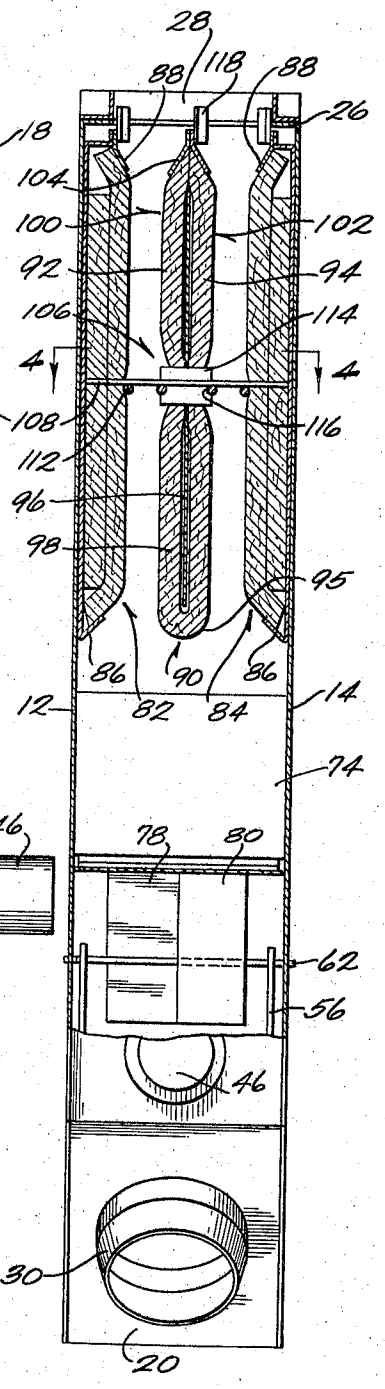
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AIR CONDITIONING TERMINAL CONTROL UNIT WITH ACOUSTICAL BAFFLE

Filed March 22, 1967 2 Sheets-Sheet 2

Fig. 1





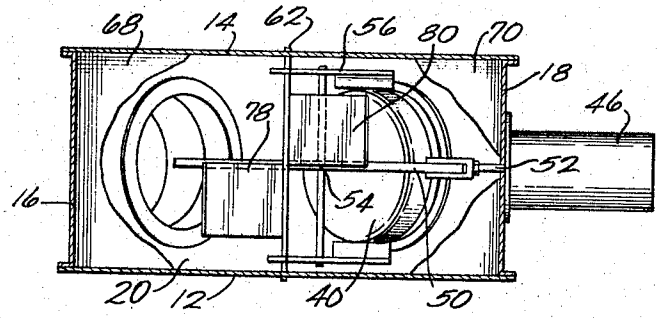


Fig. 3

Fig. 2

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AIR CONDITIONING TERMINAL CONTROL UNIT WITH ACOUSTICAL BAFFLE

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U.S. Cl. 98—38 15 Claims

ABSTRACT OF THE DISCLOSURE

This disclosure is directed to the use of a splitter baffle assembly to attenuate noise in an air conditioning terminal control unit of the type in which hot and cold air is delivered to and mixed within the unit prior to discharge into the area being serviced and which further includes a regulator for maintaining a substantially constant volume of flow through the unit. The splitter baffle assembly has oppositely facing major, planar surfaces and these surfaces are arranged parallel to the direction of air flow through the unit with only the end edge of the splitter baffle offering direct obstruction to flow. The major surfaces of the splitter baffle are covered by acoustical material and with the just-described arrangement an increased amount of acoustical material is exposed to air flow for a given space without creating a major obstruction to flow so that other functions carried on in the unit, such as flow volume control and mixing of hot and cold air, are not affected due to pressure build-up which might otherwise occur in the unit as a result of inserting acoustical material directly in the flow.

BACKGROUND OF INVENTION

Field of invention

This invention relates to terminal control units as used in air conditioning delivery systems.

Description of prior art

Terminal control units of the type to which this invention relates are used extensively in building air conditioning systems. Due to other considerations in building construction, it is generally recognized that a reduction in overall size of the terminal control units is desirable. However, the desire for reduced unit size generally presents conflicting design considerations with respect to unit capacity and noise level. For example, size is a factor in determining the volume of air which can be handled by the unit in that reduction in size makes for higher velocities and this is generally accompanied by higher pressure drops and higher noise generation, yet less space is available for noise attenuating material.

Noise transmitted into the area being serviced by a terminal control unit has two components, (1) airborne duct noise and (2) self-generated noise resulting from passage of air through the terminal unit itself. Acoustical, or broadly attenuating, material is commonly provided within the termianl unit and arranged such that delivery air flow is exposed to the acoustical material prior to being discharged into the area being serviced. This is a primary factor in noise attenuation in an air distribution system and any reduction in size of the terminal unit also results in a corresponding reduction in the space available within the unit for acoustical material. This reduction in space available for acoustical material has been one of the main factors in requiring a reduction in unit capacity as the size of the unit is decreased. Conventional practice has been to line the inner walls of the terminal unit with acoustical material. Furthermore, additional acoustical material has been provided in the form of various acoustically covered baffles arranged directly in the air flow, the shortcoming of the baffle arrangements generally being that they offer undue obstruction to air flow with attendant increase in pressure drop across the baffle. Such increased pressure drop adversely affects other functions in the unit, such as mixing of hot and cold air and flow volume control, and for that reason is undesirable.

SUMMARY OF INVENTION

Generally, terminal control units include hot and cold inlets, thermostatically controlled proportioning valves for varying the ratio of flow through the inlets, a flow regulator for maintaining a constant volume of flow and the inner walls of the units are lined with acoustical material to provide noise attenuation. This invention proposes a construction wherein additional acoustical material, i.e. acoustical material in addition to that normally provided on the inner housing walls, is supported in the path of air flow through the unit and in spaced relationship from the acoustically lined unit housing walls, but in such a manner as to increase attenuation without increasing obstruction to air flow. Preferably, the acoustical material is part of a splitter baffle which has a planar construction the opposite, major surfaces of which are generally parallel to the direction of air flow through the unit. The acoustical material extends over the oppositely facing surfaces of the splitter baffle and air flow occurs on both sides of the baffle. In addition to merely increasing the amount of air flow exposed to the acoustical material, the arrangement of the acoustical material on the splitter baffle with respect to that on the inner housing is such as to increase the ratio of air flow perimeter (that exposed to acoustical material) to area of air flow passage and thereby further increase attenuation effectiveness. The splitter baffle has a rounded leading edge presented to air flow and its opposite sides extend parallel to the air flow path terminating in a faired trailing edge to minimizez resistance and obstruction to air flow. This form of baffle achieves optimum noise attenuation in the space available and, moreover, does not appreciably obstruct air flow through the unit.

DESCRIPTION OF DRAWINGS

FIG. 1 is a longitudinal section through a terminal control unit constructed in accordance with this invention;

FIG. 2 is an end view of the terminal unit with portions of the end wall broken away to expose the interior;

FIG. 3 is a section view generally along line 3—3 of FIG. 1; and

FIG. 4 is a section view along line 4—4 of FIG. 2.

DESCRIPTION OF PREFERRED EMBODIMENT

The invention is illustrated in an end discharge unit **10** but can be incorporated in any type of terminal control unit. The unit includes an outer housing made of opposed side walls **12** and **14** connected by opposed end walls **16** and **18**. As shown in the drawings, bottom wall **20** of the housing is provided with inlet openings **22** and **24** and top wall **26** is provided with an outlet opening **28**. Duct couplings **30** and **32** are fastened to the bottom wall at inlets **22** and **24**. The couplings provide a point of connection for the duct-work (not shown) of the air delivery system in which the unit is to be used. Generally a source of hot air is connected to coupling **30** and a source of cooler air is connected to coupling **32**. As will be described more completely hereinafter, a proportioning valve assembly **34** cooperates with the hot and cold air inlets to admit the desired proportion of hot and cold air into the housing as is required to discharge air at a desired temperature from the unit.

More particularly, valve **36** includes oppositely facing valve members **38** and **40** supported on bracket **42**.

Bracket 42 is mounted for pivotal movement on rod 44. With this arrangement valve 36 can be pivoted along an arc between inlets 22 and 24. Generally valve members 38 and 40 are in the form of annular resilient gaskets which engage the inner housing walls around the inlets to insure an adequate closing seal at the inlets. As illustrated the valve is in a full closed position at inlet 24 and is movable to assume any angular position along a path of arcuate movement to a full closed position on inlet 22. Pivotal movement of valve 36 is produced by a pneumatic motor 46 attached to the housing. The pneumatic motor is controlled in a conventional manner, for example by a room thermostat or the like, and varies the position of the valve in accordance with the temperature demand of the control.

Control movement of motor 46 is transmitted to valve 36 through linkage 48. The linkage includes arm 50 connected to output rod 52 of the motor. An arm 56 is pivotally connected at 54 to arm 50 and has one end connected to bracket 42 with its opposite end fixed to rod 62 supported between side walls 12 and 14. Arm 56 engages bracket 42 through a roller-type connection 58 which is engaged in but movable with respect to a slot 60 on both sides of bracket 42. With this arrangement the linear movement of rod 52 produced by motor 46 produces movement of arm 56 about rod 62 and arm 56 carries the valve through connection 58 moving the valve 36 along an arcuate path between inlets 22 and 24. As illustrated in the drawings, operation of motor 46 will move arm 56 from the position illustrated upwardly and in a clockwise direction about rod 62 to pivot valve 36 in a counterclockwise direction away from inlet 24 and toward inlet 22.

Partitions 68 and 70 divide the interior of housing 10 into two chambers, an inlet chamber 64 and a discharge chamber 66. The partitions extend from end walls 16 and 18 and between the side walls but terminate in spaced relationship to define a restricted opening 72. Air admitted through the inlet openings must pass through opening 72 in passing from chamber 64 to chamber 66. The terminal unit is preferably intended to function as a constant volume unit and to that end a constant volume controller 74 is supported at restricted opening 72. The precise construction of the constant volume controller has not been illustrated as it forms no part of this invention and can be of any conventional construction, for example that disclosed in Patent No. 3,250,203 of Joseph W. Spradling and Gordon C. Sylvester and assigned to the assigneee of this application. For purposes of understanding this invention it should be sufficient to point out that the controller usually includes a blade, or blades, mounted for pivotal movement in the controller passage. The blade is biased toward a position of minimum obstruction to flow and is pivoted against that bias to increase obstruction as the pressure drop across the controller increases due to increased flow rate.

In order to insure thorough mixing of hot and cold air prior to passage into chamber 66, mixing baffle assembly 76 is provided on the upstream side of opening 72. More particularly, angularly disposed blades 78 and 80 converge downwardly from opening 72 and are offset laterally one from the other. With this arrangement direct passage of all air through chamber 64 to chamber 66 cannot occur and blades 78 and 80 cause sufficient turbulence and divergence of air flows into each other prior to passage through controller 74 to insure thorough mixing of hot and cold air from the inlets. This thorough mixing contributes substantially to reducing the possibility of temperature stratification of the air discharged through outlet 26.

Air delivered through opening 72 into chamber 66 passes between the opposed end and side walls of the housing and is discharged through outlet 28. In accordance with conventional practice, at least the inner surfaces of side walls 12 and 14 are lined with acoustical material 82 and 84. This acoustical material is supported between lower brackets 86 and upper brackets 88 and can be of any suitable construction. For example, the material is in the form of mats made of fiber glass and having a suitable coating over the surface of the mat which prevents air erosion without interfering with the attenuating properties of the acoustical material.

In any air delivery system a certain amount of duct noise is conveyed with the air entering the terminal unit. This duct noise is then added to the noise generated in the unit as a result of passage of air through the unit, i.e. self-generated unit noise. Air flowing through the unit must pass over acoustical material 82 and 84 before delivery through outlet 28 into the area being serviced thus permitting the acoustical material to afford a measure of noise attenuation and to insure maintaining the noise level in the serviced area below a desired maximum.

This invention proposes to reduce the overall size of the terminal unit without decreasing its capacity. It has been recognized that reducing the size of the unit also reduces the capacity which can be adequately handled in the unit because the physical size restricts the unit capacity and, also, because the space available for acoustical material is reduced. This invention is directed to the solution of this problem and proposes an arrangement which permits an increase in the amount of acoustical material which can be supported in a unit of a given size thereby allowing a reduction in unit size without reducing its capacity.

More particularly, a splitter baffle assembly 90 is supported in the housing between acoustical liners 82 and 84. As can be seen in FIGS. 1 and 2, the splitter baffle assembly is of generally planar configuration having oppositely facing major surfaces 92 and 94. Structurally the splitter baffle includes a base framework 96 and a mat 98 which extends over the opposite sides of framework 96. Mat 98 is suitably attached to the framework, for example it extends over the lower end of the framework and has its opposite ends 100 and 102 connected to a V-shaped bracket 104, which bracket also provides the splitter baffle with a trailing edge that tapers inwardly with respect to the air flow.

The splitter baffle is supported within the housing so that its vertical edges engage the end walls 16 and 18 and its opposite major surfaces 92 and 94 are parallel to air flow between the housing side walls and only its leading edge 95 is presented to air flow. Specifically, the major surfaces are in opposed parallel relation with respect to acoustical liners 82 and 84 but are spaced from the liners. An open frame 106, consisting of end supports 108, 110 and rods 112 extending between the end supports, is fastened to end walls 16 and 18. Mounting plates 114 are connected to the opposite edges of the splitter baffle, for example with a screw connection to frame 96. Each plate includes notched-out portions 116 for receipt of rods 112. The distance between the edges of the plates is greater than the distance between the inner pair of rods. To assemble the splitter baffle in the housing, it is inserted between the inner pair of rods 112, the rods bow outwardly to clear plate 114 and snap into notches 116. It should also be pointed out that the distance between surfaces 92 and 94 is less than the spacing between the inner two rods 112 so that the acoustical mat is somewhat compressed at the rods. This contributes to holding the splitter baffle assembled but the amount of compression is sufficiently small that the opposite surfaces 92 and 94 can still be considered as extending parallel to the direction of air flow. To complete the support for the baffle assembly V-shaped bracket 104 is suitably attached to a transverse bracket 118 located in the discharge opening 28, for example by spot welding or with a screw connection.

As illustrated, the splitter baffle extends between one pair of opposed inner walls of the unit housing and is parallel to the other pair of housing inner walls. The oppositely facing surfaces of the splitter baffle have a substantial extension in both a vertical and horizontal

direction but always generally parallel to the direction of flow through the housing so as to afford minimum obstruction to flow. The illustrated structure of the splitter baffle is further advantageous in that the rounded leading edge **95** and the faired trailing edge, which is attached to bracket **104**, serve to minimize obstruction to air flow. The only direct obstruction to flow presented by the splitter baffle is as a result of rounded leading edge **95** and this insures a minimal pressure drop as a result of inclusion of the splitter baffle. In addition to merely exposing more acoustical material to the air flow, attenuation is further enhanced by providing a high ratio of perimeter to area of air flow. More particularly, the approximate formula for determining attenuation is

$$\text{Attenuation (db)} = L \times 12.6\bar{a}^{1.4}P/A$$

wherein:

L=length, in feet, of the lined duct
$\bar{a}$=the coefficient of acoustic absorption
P=perimeter, in inches, of air path inside the lining
A=the area, in square inches, of the air path inside the lining

It can thus be seen that the amount of attenuation will increase as the ratio of P/A increases so that where two acoustically lined ducts have equal areas transverse to the path of flow that duct having the higher ratio of perimeter to area will provide the greater attenuation. This is achieved simply in the illustrated embodiment by providing a rectangular shaped housing and extending the splitter baffle from one wall to the other wall of one pair of opposed side walls so that the splitter baffle and the acoustically lined side walls define generally rectangular shaped flow passages.

This structural arrangement of the splitter baffle divides the air flow through the housing into two flow components, a portion of the flow passing between the baffle and liner **82** and another portion passing between the baffle and liner **84**. This virtually doubles the amount of acoustical material exposed to the air flow and also the ratio of perimeter to area of flow path is increased to thereby further enhance attenuation. With this arrangement the overall size of the unit can be reduced for a given capacity and still achieve the amount of attenuation required to maintain the noise level below an established maximum. Furthermore, the structure of the splitter baffle affords a minimum of obstruction to the air flow thereby maintaining a minimal pressure drop across the baffle so that the insertion of the splitter baffle does not adversely affect either the mixing of the hot and cold air by mixing baffles **76** nor regulation of volume flow by controller **74**.

Consistent with the desire to minimize the obstruction to air flow, the support frame for the splitter baffle is designed with this consideration in mind. More particularly, the combination of rods **112** and end members **108** and **110** provides a frame of substantially open construction. This frame, through its inner adjacent pair of rods **112**, cooperates in supporting the baffle assembly and also cooperates in supporting the acoustical liners **82** and **84**. More particularly outer rods **112** engage the surface of acoustical material **82** and **84** to contribute in supporting the acoustical liners. However, the area between the rods is open and leaves the areas between the acoustical material open offering little if any obstruction to air flow therebetween.

It will be appreciated that this invention also permits increasing the capacity of a given size unit and still maintains effective noise attenuation. Moreover, although only a single splitter baffle assembly **90** has been illustrated, any number of baffles, preferably parallel to each other, can be utilized depending on the size of the unit and the particular application.

Although but one embodiment of the present invention has been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention.

What is claimed is:

1. A terminal control unit comprising, in combination,
a housing including an inlet chamber and a discharge chamber communicating with said inlet chamber,
means defining spaced inlets opening into said inlet chamber and adapted for selective connection to delivery ducts to direct flow into said housing,
means defining an outlet in said discharge chamber spaced from said inlets so that flow introduced into said housing through said inlets passes through said inlet and discharge chambers and is discharged through said outlet,
said housing including generally opposed inner wall portions in said discharge chamber defining a flow passage to said outlet,
acoustical material in said housing between said inlets and outlet,
and means supporting said acoustical material in said discharge chamber and between and in spaced relationship from said housing inner wall portions, said means also supporting said acoustical material to divide flow through said discharge passage on opposite sides of said acoustical material and with said acoustical material having a major extension generally parallel to the direction of flow through said discharge chamber to said outlet.

2. The terminal unit of claim **1** wherein said acoustical material has a mat-like configuration and said major extension is generally parallel to said housing inner wall portions,
and including acoustical material on at least said housing inner wall portions,
the flow passage past said acoustical material characterized by having a relatively large ratio of flow passage perimeter to flow passage area.

3. The terminal control unit of claim **2** including
partition means within said housing between said inlet chamber and said discharge chamber defining a restricted opening through which flow said inlets to said outlet occurs,
and mixing baffle means disposed at said restricted opening and arranged at an angle to the air flow from said inlets to said outlet for diverting at least a portion of the flow of air from one inlet into flow from another to mix said air flows.

4. The terminal control unit of claim **3** wherein
said mixing baffle means extends upstream relative to said restricted opening,
including regulator means at said restricted opening downstream of said mixing baffle means and operative to maintain a substantially constant volume of flow through said restricted opening,
and including proportioning valve means movable with respect to said inlets to vary the ratio of flow through said inlets.

5. The terminal control unit of claim **1** wherein
said acoustical material is part of splitter baffle means, said acoustical material being generally mat-like providing, in said splitter baffle means, oppositely facing generally planar surfaces of acoustical material extending generally parallel to the direction of flow through said discharge chamber,
said splitter baffle means being operative to split flow through said discharge chamber into flow components on opposite sides of said splitter baffle means and thereby expose said flow to said oppositely facing surfaces of said splitter baffle means,
and including acoustical material on said housing inner wall portions.

6. The terminal control unit of claim **5** including
partition means within said housing between said inlet chamber and said discharge chamber defining a

restricted opening through which flow from said inlets to said outlet occurs,

and mixing baffle means in said inlet chamber converging from said opening and arranged at an angle to the flow from said inlets to said outlet for diverting at least a portion of the flow from one inlet into flow from another to mix said air flows.

7. The terminal control unit of claim **6** including

regulator means at said restricted opening downstream of said mixing baffle means and operative to maintain a substantially constant volume of flow through said restricted opening,

and including proportioning valve means movable with respect to said inlets to vary the ratio of flow through said inlets.

8. A terminal control unit comprising, in combination,

a housing including an inlet chamber and a discharge chamber communicating with said inlet chamber,

means defining hot and cold inlets opening into said inlet chamber,

means defining an outlet from said discharge chamber spaced from said inlets,

said housing being generally rectangular in cross section in said discharge chamber to provide pairs of opposed generally parallel inner walls defining a flow passage to said outlet,

acoustical material supported on said inner walls so that flow between said inlets and outlet passes said acoustical material,

generally planar splitter baffle means disposed in said discharge chamber and extending between the walls of one of said opposed pairs and including mat-like acoustical material providing oppositely facing major surfaces of acoustical material in said splitter baffle means and further including an end extending between said major surfaces,

and means supporting said baffle means with its oppositely facing surfaces extending generally parallel to said acoustically covered housing walls and with said end defining a leading edge facing upstream into said flow so that said baffle means extends generally parallel to air flow through said discharge chamber dividing air flow through said discharge chamber on opposite sides of said baffle means to expose said air flow to the acoustical material of both surfaces of said splitter baffle means and on said inner housing walls,

the flow passages defined by said splitter baffle means and said acoustically lined housing walls being characterized by a large ratio of flow passage perimeter to flow passage area.

9. The terminal control unit of claim **8** wherein said splitter baffle means is further characterized by said leading edge being generally rounded, said splitter baffle means acoustical material extending from said leading edge in the direction of extension of said inner housing walls toward said outlet and terminating in an inwardly tapering trailing edge.

10. A terminal control unit comprising, in combination,

a housing including generally opposed inner wall portions,

acoustical material on said housing inner wall portions,

means defining spaced inlets opening into said housing and adapted for selective connection to delivery ducts to direct flow into said housing.

means defining an outlet in said housing spaced from said inlets so that flow introduced into said housing through said inlets passes through said housing and is discharged through said outlet,

splitter baffle means including generally mat-like acoustical material providing, in said splitter baffle means, oppositely facing generally planar surfaces of acoustical material,

means supporting said splitter baffle means between and in spaced relationship from said housing inner wall portions to provide a flow passage on opposite sides of said splitter baffle means acoustical material and extending with said splitter baffle means acoustical material extending generally parallel to the direction of flow through said housing from said inlets to said outlet,

said splitter baffle means being operative to split flow through said housing into flow components on opposite sides of said splitter baffle means and thereby expose said flow to said oppositely facing surfaces of said splitter baffle means,

said support means including spaced apart elongated members having a predetermined spacing therebetween attributing a generally open construction to said support means,

and said splitter baffle means including spaced clip means engaged between an adjacent pair of elongated members so that said splitter baffle means is supported in said unit with minimum obstruction to air flow.

11. A terminal control unit comprising, in combination,

a housing including generally opposed inner wall portions,

acoustical material on said housing inner wall portions,

means defining spaced inlets opening into said housing and adapted for selective connection to delivery ducts to direct flow into said housing,

means defining an outlet in said housing spaced from said inlets so that flow introduced into said housing through said inlets passes through said housing and is discharged through said outlet,

splinter baffle means including generally mat-like acoustical material providing, in said splitter baffle means, oppositely facing generally planar surfaces of acoustical material,

means supporting said splitter baffle means between and in spaced relationship from said housing inner wall portions to provide a flow passage on opposite sides of said splitter baffle means acoustical material and extending with said splitter baffle means acoustical material extending generally parallel to the direction of flow through said housing from said inlets to said outlet,

said splitter baffle means being operative to split flow through said housing into flow components on opposite sides of said splitter baffle means and thereby expose said flow to said oppositely facing surfaces of said splitter baffle means,

means within said housing defining a restricted opening through which flow from said inlets to said outlet occurs,

mixing baffle means disposed at said restricted opening generally upstream of said splitter baffle means and arranged at an angle to the flow from said inlets to said outlet for diverting at least a portion of the flow from one inlet into flow from another to mix said air flows,

and said mixing baffle means comprising first and second laterally offset blades converging into said flow in overlaying relationship with at least a portion of said restricted opening.

12. A terminal control unit comprising, in combination,

a housing generally rectangular in cross section to provide pairs of opposed generally parallel inner walls,

acoustical material supported on said inner walls,

means defining hot and cold inlets opening into said housing,

means defining an outlet from said housing spaced from said inlets,

said inlets and outlets arranged with said acoustical material therebetween so that flow between said inlets and outlet passes said acoustical material,

generally planar splitter baffle means extending between

the walls of one of said opposed pairs and including mat-like acoustical material providing oppositely facing major surfaces of acoustical material in said splitter baffle means and further including an end extending between said major surfaces,

means supporting said splitter baffle means with its oppositely facing surfaces extending generally parallel to air flow between said acoustically covered housing walls and with said end defining a leading edge facing upstream into said flow so that said splitter baffle means divides air flow between said inlets and outlet on opposite sides of said baffle means to expose said air flow to the acoustical materials of both surfaces of said splitter baffle means and on said inner housing walls,

the flow passages defined by said splitter baffle means and said acoustically lined housing walls being characterized by a large ratio of flow passage perimeter to flow passage area,

means within said housing defining a restricted opening through which flow from said inlets to said outlet occurs,

and mixing baffle means at said restricted opening upstream of said splitter baffle means ararnged at an angle to said opening for mixing the flows from said inlets prior to said splitter baffle means.

13. The terminal control unit of claim **12** wherein said mixing baffle means comprises first and second laterally offset blades converging into said flow in overlaying relationship with at least a portion of said restricted opening.

14. The terminal control unit of claim **12** including regulator means at said restricted opening, downstream of said mixing baffle means and operative to maintain a constant volume of flow through said opening, and adjustable proportioning valve means movable with

respect to said inlets to vary the ratio of flow through said inlets.

15. The terminal control unit of claim **12** wherein said support means includes a plurality of relatively spaced elongated members with an adjacent pair of said elongated members engaging said oppositely facing surfaces of said splitter baffle means to cooperate in supporting said baffle means,

said acoustical material on said splitter baffle means being compressible and having a relaxed condition wherein the dimension between the opposite surfaces thereof is greater than the spacing between said pair of elongated members so that said splitter baffle means acoustical material is compressed by said pair of elongated members,

and the outermost elongated members engaging and cooperating in supporting the acoustical material on said housing walls.

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U.S. Cl. X.R.

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