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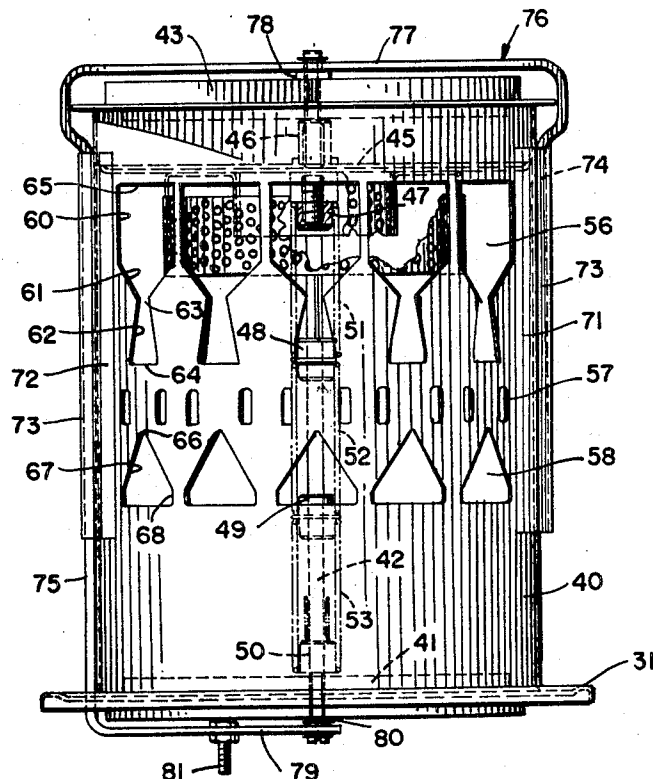
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[54] **CONSTANT VOLUME REGULATORS AND AIR
DISTRIBUTION APPARATUS EMBODYING SAME**
12 Claims, 8 Drawing Figs.

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[51] Int. Cl. F15d 1/00
[50] Field of Search 137/503,
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625.31, 625.37; 138/37, 40, 43, 46; 251/205,
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ABSTRACT: Air distribution apparatus for heating, ventilating and air conditioning systems embodying constant volume regulators and bypass valves having hollow cylinder with air passages of predetermined shape and spring-loaded piston movable axially in cylinder by pressure differential to maintain substantially constant volume under varying supply pressures.



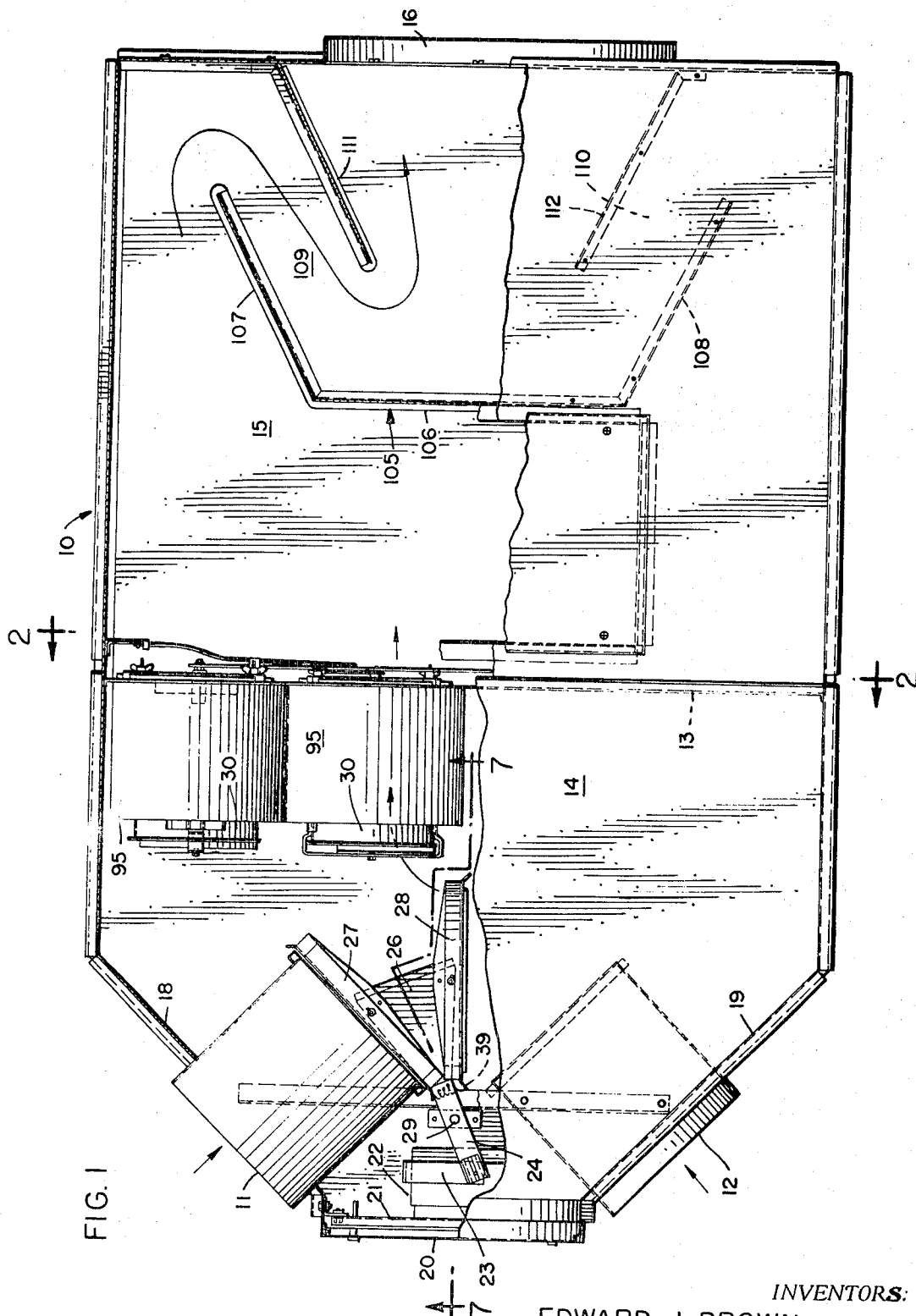


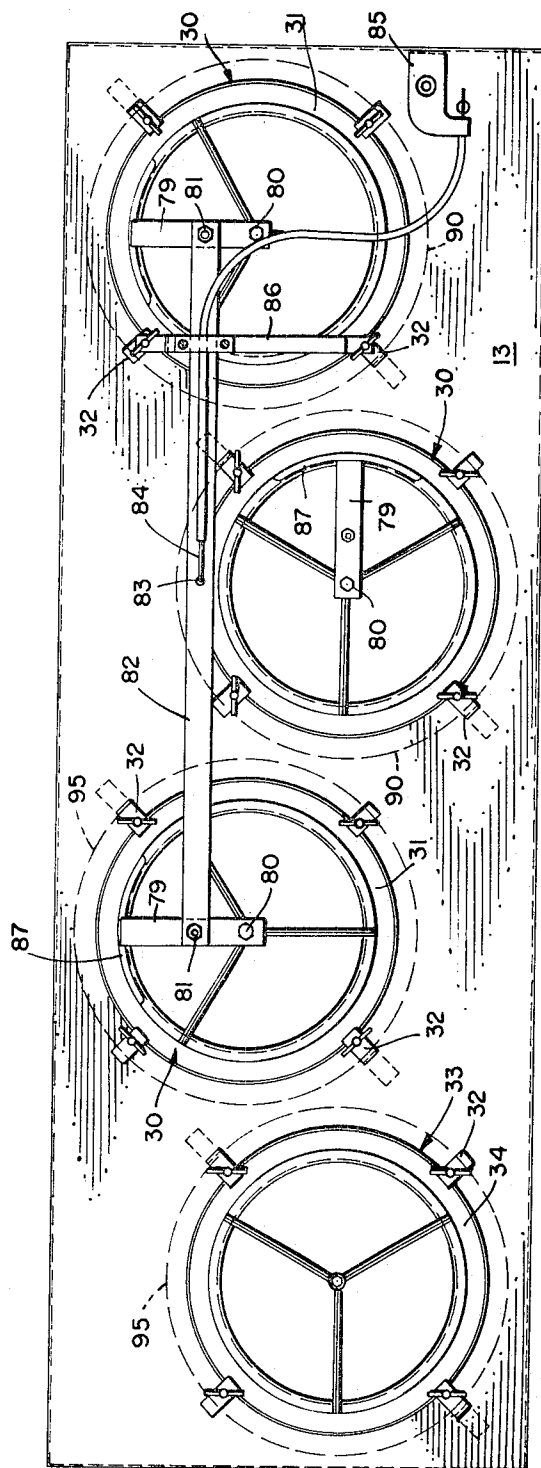
FIG. 1

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FIG. 2



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FIG. 4

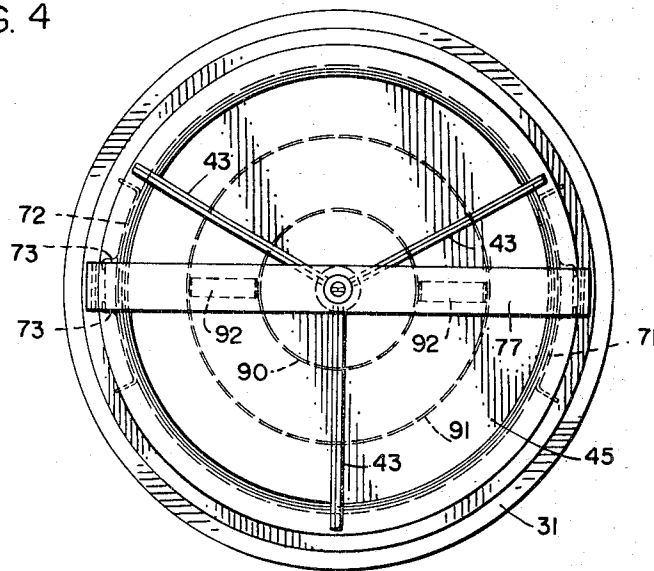
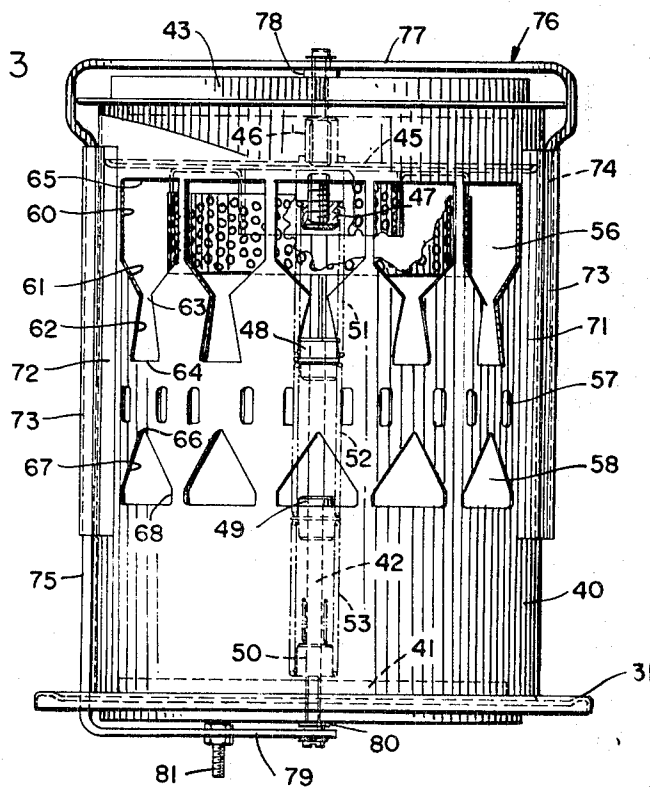


FIG. 3



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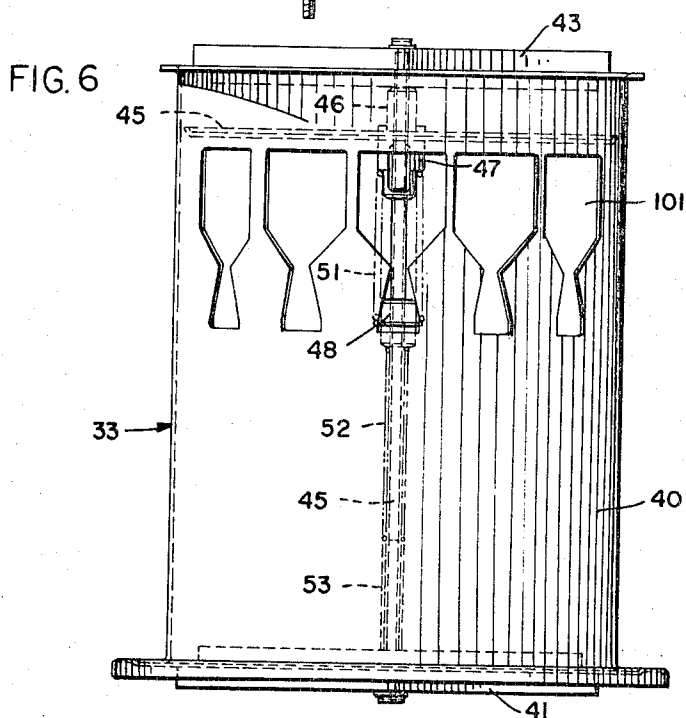
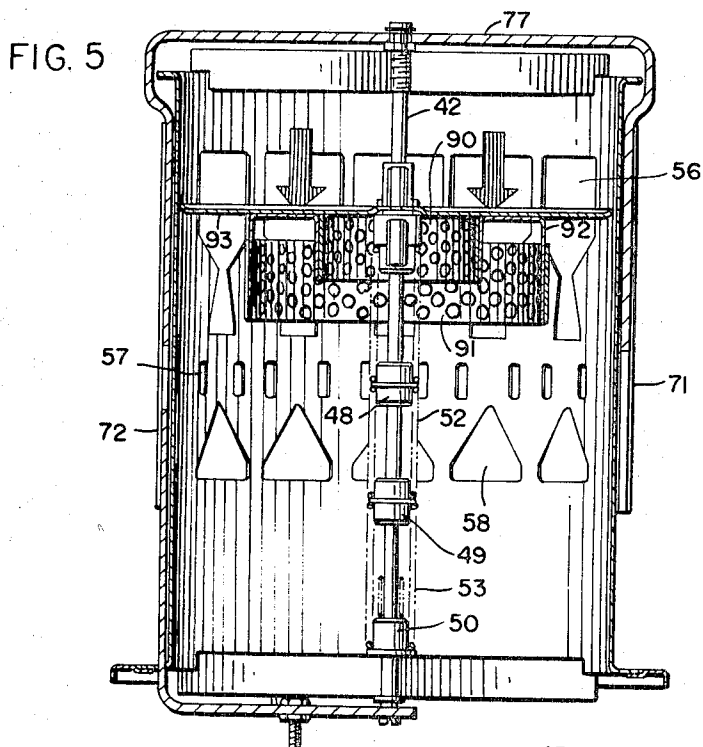
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FIG. 7

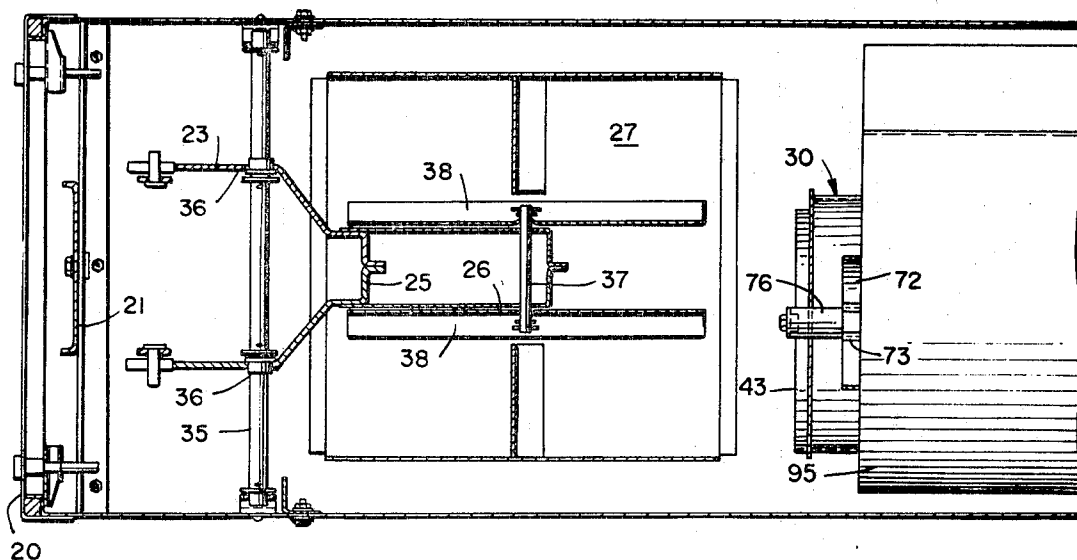
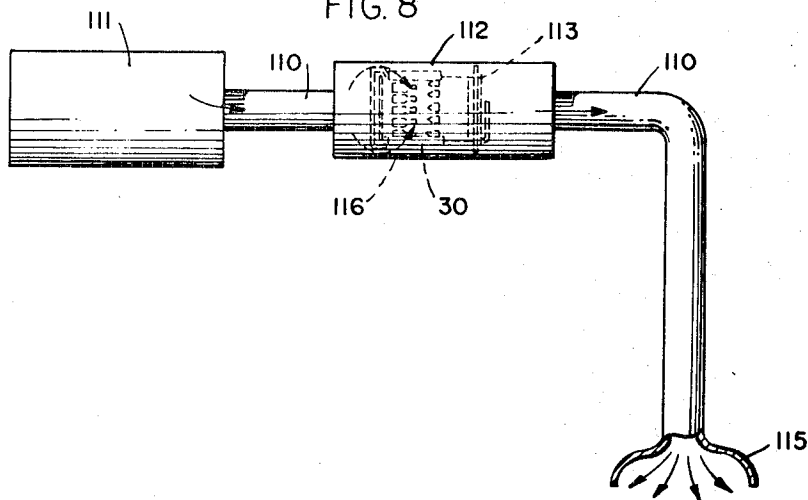


FIG. 8



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CONSTANT VOLUME REGULATORS AND AIR DISTRIBUTION APPARATUS EMBODYING SAME

BACKGROUND OF THE INVENTION

It is desirable in the distribution of air in a building to provide a means for maintaining a substantially constant volume of flow of air at the terminal units whereby air is supplied through air diffusers, grilles or other terminal units at substantially constant volume. The pressure in an air distribution system is subject to fluctuations due primarily to changes in load or demand in various portions of the distribution system. Furthermore, in systems embodying the supply of cool air and hot air, the mixing or metering thereof near the terminal unit in response to thermostat or other temperature control in the zone to be heated or cooled or ventilated introduces another variable in pressure of the supply air. This variable arises from temperature responsive changes in proportions of cool air supply and hot air supply to a given terminal unit. Such changes result from differences in pressures between the two supplies, which in turn affect the pressure of the resultant mixture when the relative proportions thereof are changed.

Regulators for maintaining a substantially constant volume of air supply under systems having fluctuations in pressure in the high pressure side of the system are known in the art. One well known type embodies a flexible member which is moved into and out of covering relationship with air passages of predetermined shape in a wall dividing the high pressure side and the low pressure side of a regulator unit in the air distribution system. A common application for constant volume regulator units is as components of a mixing box having a hot air and a cold air supply and a metering means for varying the proportions thereof in response to temperature demands of the zone being supplied with the air.

BRIEF DESCRIPTION OF THE INVENTION

This invention concerns improvements in constant volume regulators and bypass valves used in air distribution systems, and particularly in mixing boxes of the aforesaid nature. The constant volume regulators comprise hollow cylinders having a spring-loaded piston which is axially movable in the cylinder. The cylinder is spring-biased toward the upstream or high pressure end and is driven against the spring bias by the pressure difference between the upstream face of the piston and the downstream face on the low pressure side. The wall of the cylinder is provided with a series or grouping of apertures or air passages shaped in predetermined forms to maintain substantially constant volume discharged from the regulator under various pressures on the high pressure side in coaction with movement of the piston in response to such changes. Air from the high pressure side flows from the outside of the cylinder to the inside thereof, wherein the low pressure side of the regulator exists.

The constant volume regulators of the invention further embody transversely curved, diametrically opposed plates. These plates conform to and are in contact with or in close proximity to the outer surface of the cylinder and can be orbited to cover a portion of the air passages to the extent desired. This structure permits adjustment of the volume capacity of the particular regulator.

The bypass valve is similar in structure to the constant volume regulator. The essential difference thereof is the employment of only one group of apertures which are closed off by the piston at relatively low pressure on the high pressure side. The bypass valve is used in conjunction with the pressure regulators to increase in volume capacity of a mixing box or the like at low pressures on the high pressure side and, by virtue of its single group of apertures, becomes essentially inactivated in terms of airflow therethrough after the differential in pressure between the high pressure side and the low pressure side reaches a value of less than the maximum which can be handled by the constant volume regulator.

The constant volume regulator further has on the low pressure face of its piston a pair of concentric cylinders having a

large number of perforations therein. The inner cylinder rests against the low pressure face of the piston while the outer cylinder has its lower edge spaced from said face to permit free flow of air to the center portion of the low pressure face. The perforated cylinders function as baffles to distribute airflow more uniformly in the cylinder and to suppress a high velocity jet which otherwise forms in the axial center portion of the cylinder.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be further understood and appreciated from the following description of preferred embodiments thereof, which are illustrated in the drawings, wherein:

FIG. 1 is a top plan view, partly in section, of a dual duct mixing box embodying the constant volume regulators and bypass valves of the invention;

FIG. 2 is an end elevation of the cross partition wall containing said regulators and valves as viewed from section plane 2-2 of FIG. 1;

FIG. 3 is a side elevation of the constant volume regulator;

FIG. 4 is a top plan view thereof;

FIG. 5 is a diametric cross section thereof;

FIG. 6 is a side elevation of a bypass valve;

FIG. 7 is a section taken on section line 7-7 of FIG. 1; and

FIG. 8 is a diagrammatic view of a takeoff duct using a single constant volume regulator.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, an exemplary use of the constant volume regulators and bypass valves is illustrated. This FIG. shows a mixing box 10 having a cylindrical inlet passage 11 and a second cylindrical inlet passage 12 for the admission of cool air and heated air through respective passages into the high pressure side 14 of the mixing box. The high pressure side 14 is divided by the cross wall 13 from the low pressure side 15. Air is discharged from the mixing box through the low pressure side port 16 into a duct suitably connected thereto.

The mixing box has diagonal end wall segments 18 and 19 and a middle end wall segment provided with a removable cover 20. The box has, behind the cover 20, a frame structure 21 on which is mounted an air cylinder 22. The piston of said cylinder (not shown) is operatively connected by a clevis assembly 23 to one end of the pivot arm 24. The opposite end thereof has a nose 25 fitted in triangular shell 26, which is affixed thereon. The shell 26 carries plate valves 27 and 28 which are adapted to respectively close the inner ends of ports 11 and 12. The plate valves 27 and 28 are pivotally supported on shell 26 by pins 37 and L-bars 38 on the back faces of plate valves 27 and 28. The plate valves are connected by coil spring 39, which stabilizes the plate valves when they are not seated but have enough give to allow them to pivot into tight seating on ports 11 or 12 when brought into contact therewith.

By means well known in the art, the air cylinder 22 is activated in response to a thermostatic or other temperature control of the air pressure control system, and moves the plate valves 27 and 28 to meter or proportion the requisite amounts of heated and cooled air to the high pressure side 14 in response to the heating or cooling demand of the zone being supplied with air from the mixing box. The pivot support for the pivot assembly 24 comprises a post 35 and pivot bearings 36.

The constant volume regulator 30 is situated between the high pressure side 14 and the low pressure side 15. In the illustrated embodiment, three constant volume regulators 30 are mounted in holes in the cross wall 13. These regulators have ring flanges 31 seated against the downstream face of the wall 13 about the apertures therein. The regulator is held in position by utilization of suitable mounting means such as conventional wing bolt clamps 32, which clamp against the flange 31.

The illustrated mixing box also contains a bypass valve 33. This valve is mounted similarly to the constant volume regulators in a hole cut in the cross wall 13 with utilization of wing bolt clamps 32 pressing against the flanges 34.

The constant volume regulator is illustrated in detail in FIGS. 3—5. It comprises a hollow, sheet metal cylinder 40 having the aforesaid ring flange 31 at the downstream end thereof. An axial shaft 42 extends through the center of the cylinder and is supported therein by spider arms 41 and 43, the radially outer ends of which are fixedly secured to the ends of the cylinder 40.

The axial shaft 42 slidably supports a lightweight piston 45, which has a hub 46 slidably mounted on the rod 42. The periphery of the piston is in close proximity to, but spaced from, the inner face of cylinder 40. It does not rub or touch cylinder 40 and, while there is some air leakage past the edge of the piston, it is not enough to materially affect substantially constant volume regulation. The rod 42 also has slidably mounted thereon a spring mounting member 47 contiguous to the downstream face of the piston 45, two spring spacer members 48 and 49 at intermediate points along the rod, and a terminal spring spacer or mounting member 50 contiguous to the spider 41. A series of coil springs 51, 52 and 53 are mounted between respective spacers to give a unit wherein each spring can act individually and wherein the springs collectively provide a resilient bias against movement of the piston 45.

The upstream, high pressure end of the cylinder 40 is open whereby piston 45 is moved against the bias of the springs 51—53 by the pressure differential between the high pressure side 14 and low pressure side 15. The air passes to the low pressure side through a series of air passages or ports arranged in groups of like passages or ports at axial intervals in the cylindrical wall of cylinder 40. The first series of air passages 56 is operative until such time as the piston 45 has moved to a position past such passages. The same is true of the second series of slotlike passages 57. The third series of passages 58 may be inactivated in part by movement of the piston, but the piston never completely passes these passages 58. This is a precautionary measure to avoid a substantially complete blocking of flow from the high pressure side to the low pressure side. For effecting this result, the unit may have a stop for the piston 45 or, as in the illustrated embodiment, at full compression of the springs 51—53, the passages 58 are not fully blocked.

As the piston moves from its home position (FIG. 3) in response to such pressure differentials, the total opening or orifice area for passage of air through the cylinder 40 progressively decreases. The first series of openings 56 comprise a first segment wherein opposite sides 60 thereof are substantially parallel. At approximately the mid length of the openings 56, the opposite side edges thereof taper inwardly at 61 to a narrow neck 63. Thereafter the opposite side edges 62 flare outwardly at a less acute angle to the axis of the cylinder. The end 64 and the end 65 of passages 56 preferably are straight and at right angles to the axis of the cylinder 40.

The upstream series of apertures 58 have a pointed end 66, flaring side edges 67, and short, upstream side edges 68 which are parallel to the axis of the cylinder. At least a portion of the openings 58 are never inactivated by the piston 45. This is a safety precaution to prevent substantially complete blocking of airflow from the high pressure side to the low pressure side when unusual or unexpected high pressures occur in the high pressure side of the system.

The shapes of the openings 56, 57 and 58 are dictated in part by the orifice or passage area for various pressure differentials and the relative position of the piston with given pressure differentials, and in part by structural or strength requirements in the cylinder 40. Ideally, the outward flare of side edges 62 of passages 56 would continue axially along the cylinder until they merged with the openings 58. However, such structure would substantially weaken the center portion of the cylinder 40 in terms of structural strength. As a compromise between strength considerations and flow considerations, the portion of the cylinder between the passages 56 and 58 has the slotted passages 57 which give sufficient airflow in this portion of the cylinder, and, at the same time, provide sufficient material in the center portion to give it adequate strength.

The openings or passages 56—58 do not extend completely around the circumference of the cylinder 40. The portions thereof beneath the arcuate valve plates 71 and 72, called curtains, do not have passages. When the plates or curtains 71 and 72 are positioned as shown in FIGS. 3 and 4, the constant volume regulators 30 are at full volume capacity. These curtains or plates 71 and 72, however, may be orbited to cover any part or whole up to a total of four passages 56, four passages 58, and eight passages 57. Each curtain or plate can cover up to one-half of the aforesaid totals. The curtain may also be of flexible construction and retracted on a roller to uncover ports to be used.

The curtains or plates 71 and 72 are transversely arcuate in an arc corresponding to the arc of the cylinder 40. The transversely arcuate portions each have an axial channel 73. One channel 73 receives the leg 74 of the curtain rotating member 76. The other channel 73 receives the leg 75.

The legs 74 and 75 are connected by a crossleg 77 which is pivotally supported at its midpoint by a bearing 78. The latter is supported on the hub of the spider arms 43. The opposite end of the arm 75 is supported by arm 79, which in turn is rotatably journaled by bearing 80 on spider arms 41.

Accordingly, by rotating the unit 76 on its pivot bearings 78 and 80, the plates or curtains 71 and 72 can be orbited into covering or uncovering relationship with the passages or openings 56—58 to increase or decrease the orifice or passage area for passage of air through the cylinder 40.

One or more of the volume regulators 30 may be connected to a control manipulated externally of the mixing box 10 for purposes of moving the curtains or plates 71 and 72. For such purpose, the arm 79 may have thereon a bolt 81 connected to a gang bar 82. The gang bar 82 is connected to the arm 79 of two constant volume regulators 30. A screw 83 connects the end of a flexible cable 84 the gang bar 82, the opposite end of the flexible cable being connected to a cable activating mechanism 85 of conventional construction. Thus, by movement of the cable by a control knob or handle (not shown) located externally of the mixing box, the volume capacity of the mixing box can be increased or decreased by the ganged movement of curtains or plates on the two regulators. The curtains may also be motor operated in response to a thermostat to vary the controlled volume of air automatically. The motor operator may be connected to a remote switch within the conditioned space to permit remote, manual resetting of the controlled volume.

The flexible cable 84 is supported at its midpoint by a bar support 86 which is attached to the partition wall 13 by the aforesaid wing bolt clamps 32. An arcuate slot 87 at the base of flange 31 of the constant volume regulators 30 accommodates orbital movement of the arm 75.

Referring to FIGS. 3 and 5, piston 45 has a pair of concentric baffles 90 and 91 on the downstream face 93. The baffles are made in the form of cylinders of perforated material, such as perforated metal. The inner baffle 90 is seated in actual or approximate contact on the face 93 and is held thereon by a bracket 92. The bracket 92 also supports the outer baffle 91 with the upstream edge thereof in spaced relation to the face 93. The distance of such spacing is sufficient to permit free flow of air between outer baffle 91 and the face 93 to the central portion of the piston. As aforesaid, the baffles function as noise suppressers by reducing the otherwise formed high velocity jet in the axially central portion of the volume regulator.

Referring to FIGS. 1 and 2, the constant volume regulators 30 and also the bypass valve 33, hereinafter described, have a cylindrical sleeve thereabout. Each sleeve is mounted on the partition wall 13 by suitable means. The function of each sleeve 95 is to stabilize airflow approaching the ports or orifices of the constant volume regulator and/or bypass valve whereby the latter function in the intended manner. Without such sleeves, the response of the constant volume regulators to changes in pressure differential is more erratic.

The sleeves 95 are concentric with the cylinders 40 and are sufficiently large in diameter so that the ring shaped space therebetween has an area which is plus or minus 20 percent of the total area of the orifices 57—59 of the constant volume regulator. This area relationship provides the desired stabilization of airflow through the openings 57—59 and eliminates erratic response of the constant volume regulator piston to changes in pressure differential.

The bypass valve 33 is of a construction similar to the constant volume regulator 30. Where applicable, like numerals designate like parts. However, it has only one series of ports 101 corresponding in position and shape to the ports 56 of the constant volume regulator 30. The shape of ports 101 is not of critical importance. The bypass valve 33 is employed in a mixing box or similar unit for the purpose of increasing the volume capacity of the mixing box at low pressure differentials, e.g., in the order of 1.5 inches water and below, between the high pressure and low pressure side. It responds to pressure differentials in a manner similar to a constant volume regulator in terms of movement of the piston 45. When the piston has moved past the ports or openings 101, the bypass valve becomes inactivated in terms of appreciable air passage and airflow between the high pressure side 14 and low pressure side 15 occurs only through the volume regulators.

The air in low pressure side 15 is deflected by baffle 105 comprising midwall 106, which is parallel to cross wall 13, and outwardly slanting wings 107 and 108 into flow channels 109 and 110. The latter are formed by wings 107 and 108 and slanting baffle walls 111 and 112. The airstream then turns and the air is discharged through port 16. The outer walls of the mixing box 10 and the baffles 105, 111 and 112 preferably are lined with sound absorbent material.

Thus, at relatively low pressures at the high pressure side 14, all port areas of the constant volume regulators and bypass valve are exposed. The springs 51—53 and piston 45 in the respective regulators 30 comprise pressure responsive units whereby the relative axial position of the piston in the cylinder 40 is at a definite location for a given pressure difference. A unique feature of the subject regulators is that the piston assumes approximately the same axial position for a given pressure difference regardless of total volume flow. There is no need to adjust the loading on springs 51—53 when the total volume flow of the unit is to be increased or decreased. The latter is achieved by increasing or decreasing blocking or coverage of ports 56—58 by the plates or curtains 71 and 72. Known regulators either increase spring load on the spring biased element or relocate the spring biased element to vary the controlled volume. This unit varies the controlled volume with a device completely separate from the spring biased element.

FIG. 8 is a diagrammatic illustration of the use of a single constant volume regulator 30 in a takeoff duct. Takeoff duct 110 from a main duct 111 has a cylindrical housing 112 provided therein. This housing has a ring shaped bulkhead 113 having a round opening in which is mounted the constant volume regulator 30 by the same means as heretofore described for mounting constant volume regulators in the partition wall 13. The air supplied to the constant volume regulator 30 is discharged at relatively constant volume through the discharge end of takeoff duct 110 to a ceiling diffuser 115 or other supply outlet. The area of ring shaped space between the cylindrical wall of the volume regulator 30 and the cylindrical wall of the housing 112 is equal to (plus or minus 20 per cent) the total area of the ports in the cylindrical wall of the constant volume regulator.

It is thought that the invention and its numerous attendant advantages will be fully understood from the foregoing description, and it is obvious that numerous changes may be made in the form, construction and arrangement of the several parts without departing from the spirit or scope of the invention, or sacrificing any of its attendant advantages, the form herein disclosed being preferred embodiments for the purposes of illustrating the invention.

We claim:

1. Air distribution apparatus for volume regulation of air-flow comprising a hollow cylinder, a piston in said cylinder, the periphery of said piston being in close proximity to the cylindrical wall of said cylinder, means mounting said piston for axial movement through said cylinder from home position near one end of said cylinder toward the opposite end thereof in response to air pressure differentials on opposite faces of said piston, spring means for biasing said piston toward home position when said piston is moved axially in said cylinder in response to said pressure differentials, perforated baffle walls on the low pressure face of said piston, and the cylindrical wall of said cylinder having therein a series of orifices of varying dimensions at axially spaced intervals along said wall in the range of movement of said piston, whereby volume of air flow through said orifices into said cylinder and discharged through said opposite end is regulated by the position of said piston to maintain substantially constant flow discharge from said opposite end of said cylinder.
2. Apparatus as claimed in claim 1, wherein said baffle walls are arranged in concentric rings with the lower edge of the outer ring spaced from said low pressure face.
3. Air distribution apparatus for volume regulation of air-flow comprising a hollow cylinder, a piston in said cylinder, the periphery of said piston being in close proximity to the cylindrical wall of said cylinder, means mounting said piston for axial movement through said cylinder from home position near one end of said cylinder toward the opposite end thereof in response to air pressure differentials on opposite faces of said piston, spring means for biasing said piston toward home position when said piston is moved axially in said cylinder in response to said pressure differentials, the cylindrical wall of said cylinder having therein a series of orifices of varying dimensions at axially spaced intervals along said wall in the range of movement of said piston, a member contiguous to the outer face of said cylinder, and means independent of said piston and spring means for moving said member into and out of covering relationship with a portion of said orifices to vary the controlled air volume, whereby volume of airflow through said orifices into said cylinder and discharged through said opposite end is regulated by the position of said piston to maintain substantially constant flow discharge from said opposite end of said cylinder.
4. Air distribution apparatus as claimed in claim 3, wherein said last mentioned means comprises arm means rotatably supported on said apparatus and carrying said member for orbital movement about said cylinder to move said member into and out of covering relationship with said portion of said orifices to vary the controlled air volume.
5. Air distribution apparatus for volume regulation of air-flow comprising a hollow cylinder, a piston in said cylinder, the periphery of said piston being in close proximity to the cylindrical wall of said cylinder, means mounting said piston for axial movement through said cylinder from home position near one end of said cylinder toward the opposite end thereof in response to air pressure differentials on opposite faces of said piston, spring means for biasing said piston toward home position when said piston is moved axially in said cylinder in response to said pressure differentials, the cylindrical wall of said cylinder having therein a series of orifices of varying dimensions at axially spaced intervals along said wall in the range of movement of said piston, a cylindrical housing about said hollow cylinder in surrounding relationship to the portion thereof containing said orifices, and the ring shaped cross section of the space between said cylindrical housing and said hollow cylinder being substantially equal to, plus or minus 20 percent the total area of said orifices, whereby volume of air-flow through said orifices into said cylinder and discharged through said opposite end is regulated by the position of said piston to maintain substantially constant flow discharge from said opposite end of said cylinder.
6. Air distribution apparatus for constant volume regulation of airflow comprising a hollow cylinder, a rod extending axially through and concentric in said cylinder, a piston slidably

supported on said rod for movement from home position adjacent one end of said cylinder toward the opposite end thereof, the periphery of said piston being in close proximity to the cylinder wall of said cylinder, coil spring means about said rod and biasing said piston toward home position when said piston is moved axially in said cylinder in response to a pressure differential on opposite faces thereof, said cylinder having in the cylindrical wall thereof a series of axially spaced orifices of relative size and shape to provide substantially constant flow discharge from said apparatus upon axial movement of said piston in response to said pressure differentials, arm means rotatably journaled on said rod externally of said cylinder, and an arcuate plate supported on said arm means in facing relationship to said cylinder whereby said plate may be rotated into and out of covering relationship with a portion of said orifices, whereby volume of airflow into said cylinder through said orifices is regulated by the position of said piston to maintain substantially constant flow discharge from said opposite end of said cylinder.

7. Air distribution apparatus for constant volume regulation of airflow comprising a hollow cylinder, a rod extending axially through and concentric in said cylinder, a piston slidably supported on said rod for movement from home position adjacent one end of said cylinder toward the opposite end thereof, the periphery of said piston being in close proximity to the cylinder wall of said cylinder, a plurality of coil springs separated by spacer members with both slidably supported on and about said rod and biasing said piston toward home position when said piston is moved axially in said cylinder in response to a pressure differential on opposite faces thereof, and said cylinder having in the cylindrical wall thereof a series of axially spaced orifices of relative size and shape to provide substantially constant flow discharge from said apparatus upon axial movement of said piston in response to said pressure differentials, whereby volume of airflow into said cylinder through said orifices is regulated by the position of said piston to maintain substantially constant flow discharge from said opposite end of said cylinder.

8. Air distribution apparatus for constant volume regulation of airflow comprising a hollow cylinder, a rod extending axially through and concentric in said cylinder, a piston slidably supported on said rod for movement from home position adjacent one end of said cylinder toward the opposite end thereof, the periphery of said piston being in close proximity to the cylinder wall of said cylinder, coil spring means about said rod and biasing said piston toward home position when said piston is moved axially in said cylinder in response to a pressure differential on opposite faces thereof, said cylinder having in the cylindrical wall thereof a series of axially spaced orifices of relative size and shape to provide substantially constant flow discharge from said apparatus upon axial movement of said piston in response to said pressure differentials, a cylindrical housing about said hollow cylinder in surrounding relationship to the portion thereof containing said orifices, and the ring shaped cross section of the space between said cylindrical housing and said hollow cylinder being substantially equal to, plus or minus 20 percent, the total area of said orifices, whereby volume of airflow into said cylinder through said orifices is regulated by the position of said piston to maintain substantially constant flow discharge from said opposite end of

said cylinder.

9. A constant volume regulator device for use in takeoff ducts comprising a hollow cylindrical housing, air inlet means at one end thereof and air outlet means at the other end thereof, a bulkhead in said housing, a constant volume regulator mounted in said bulkhead, said regulator comprising a hollow cylinder, a piston in said cylinder, the periphery of said piston being in close proximity to the cylindrical wall of said cylinder, means mounting said piston for axial movement through said cylinder from home position near one end of said cylinder toward the opposite end thereof in response to air pressure differentials on opposite faces of said piston, spring means for biasing said piston toward home position when said piston is moved axially in said cylinder in response to said pressure differentials, and the cylindrical wall of said cylinder having therein a series of orifices of varying dimensions at axially spaced intervals along said wall in the range of movement of said piston, whereby volume of airflow through said orifices into said cylinder and discharged through said opposite end is regulated by the position of said piston to maintain substantially constant volume flow discharge from opposite ends of said cylinder, and the respective diameters of said housing and said hollow cylinder of said regulator being such that the ring shaped cross section of the space therebetween is equal to, plus or minus 20 percent, of the total area of said orifices in said hollow cylinder.

10. A regulator device as claimed in claim 9, a member contiguous to the outer face of said cylinder, and means independent of said piston and spring means for moving said member into and out of covering relationship with a portion of said orifices to vary the controlled air volume.

11. Air distribution apparatus for volume regulation of air flow comprising a hollow cylinder, a piston in said cylinder, the periphery of said piston being in close proximity to the cylindrical wall of said cylinder, means mounting said piston for axial movement through said cylinder from home position near one end of said cylinder toward the opposite end thereof in response to air pressure differentials on opposite faces of said piston, spring means for biasing said piston toward home position when said piston is moved axially in said cylinder in response to said pressure differentials, and the cylindrical wall of said cylinder having therein a series of orifices of varying dimensions at axially spaced intervals along said wall in the range of movement of said piston, said orifices including a first series of orifices extending longitudinally of said cylinder with the respective opposite sides thereof, in the direction away from said home position, being first substantially parallel, then tapering inwardly to a narrow neck, and then flaring outwardly, whereby volume of airflow through said orifices into said cylinder and discharged through said opposite end is regulated by the position of said piston to maintain substantially constant flow discharge from said opposite end of said cylinder.

12. Air distribution apparatus as claimed in claim 11 wherein said orifices further include a second series of orifices more remote from said home position than said first series of orifices and the respective side edges thereof, in the direction away from home position, first flaring outwardly and then being parallel to the axis of the cylinder.