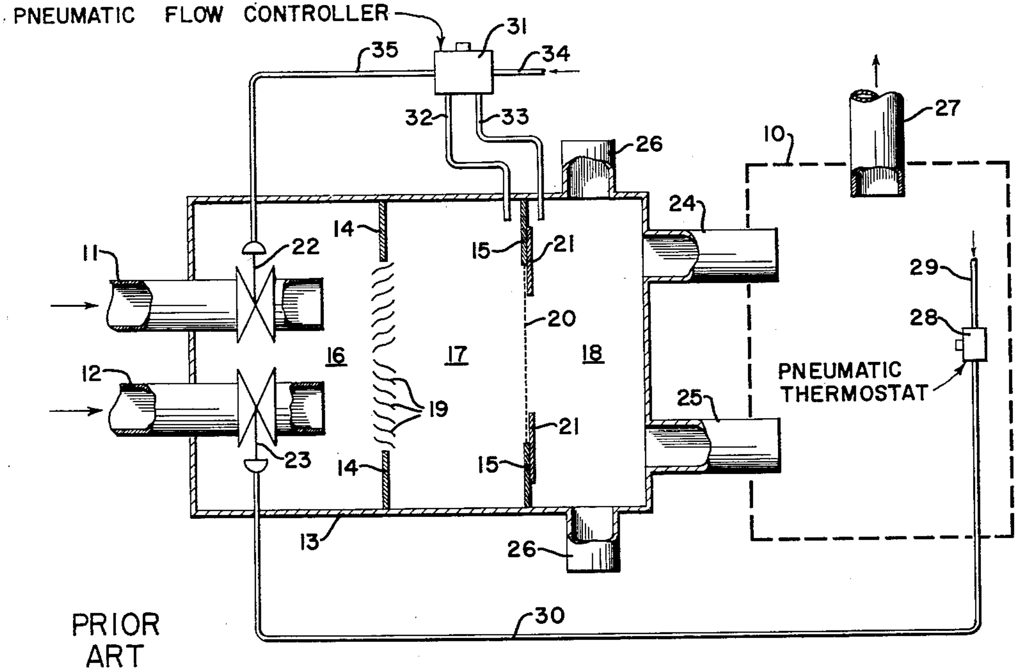
March 20, 1962 A. P. JENTOFT **3,026,041**

CONDITIONED AIR DISTRIBUTION

Filed May 6, 1960 4 Sheets-Sheet 1



PRIOR ART

Fig. 1

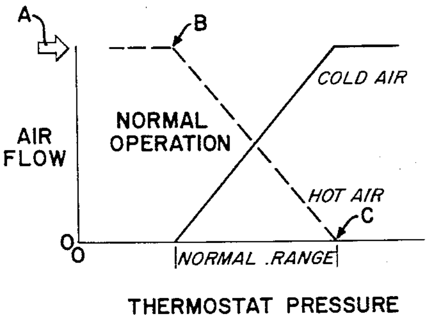


Fig. 2

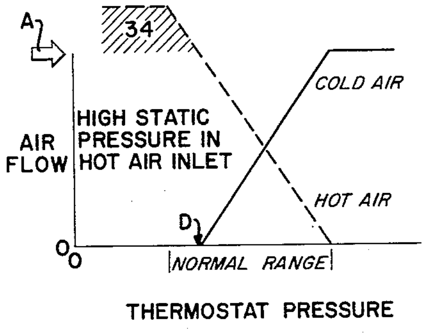


Fig. 3

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CONDITIONED AIR DISTRIBUTION

Filed May 6, 1960 4 Sheets-Sheet 2

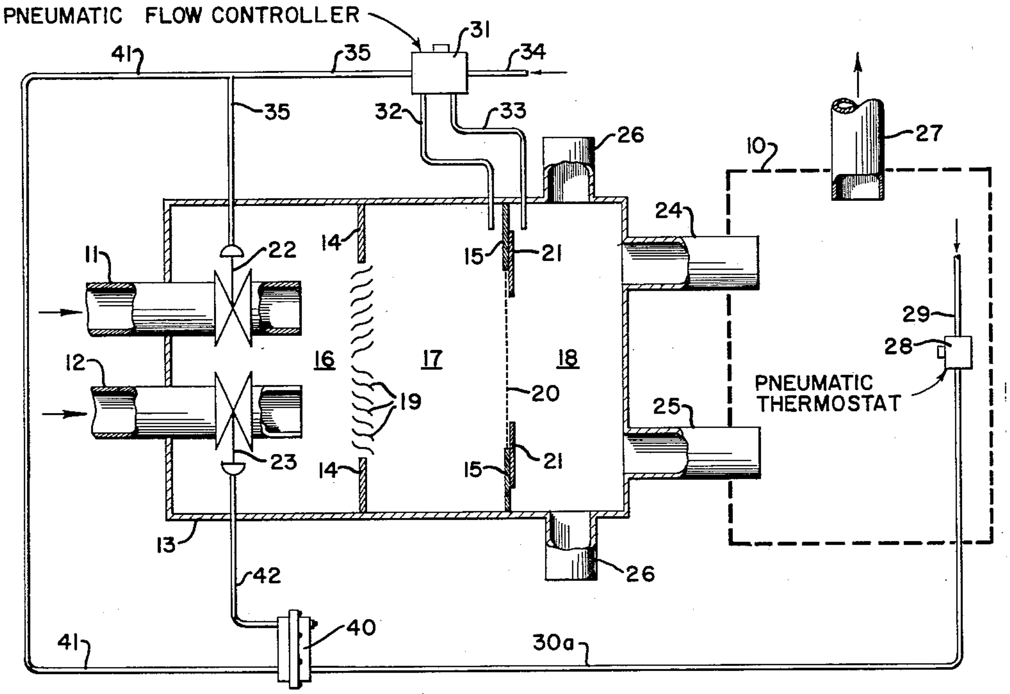
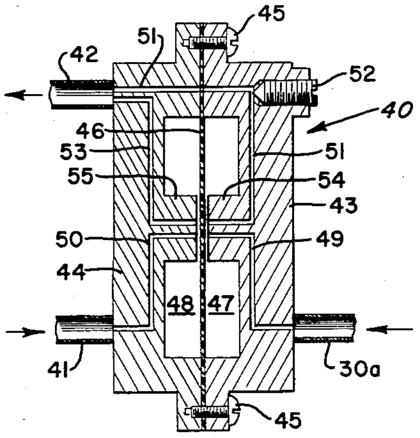


Fig. 4



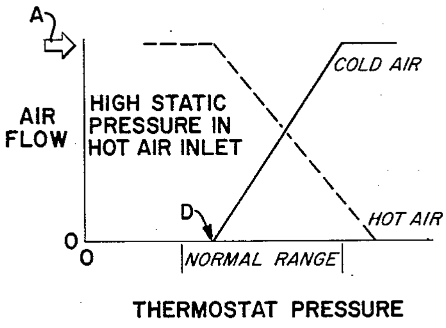


Fig. 6

Fig. 5

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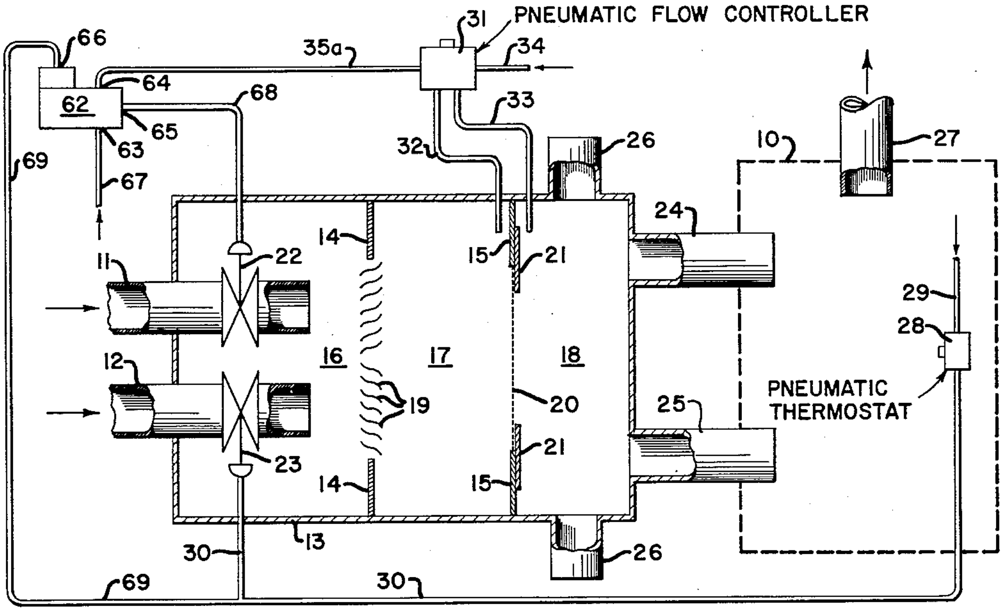

Fig. 8

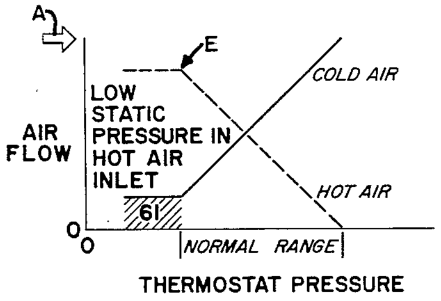

Fig. 7

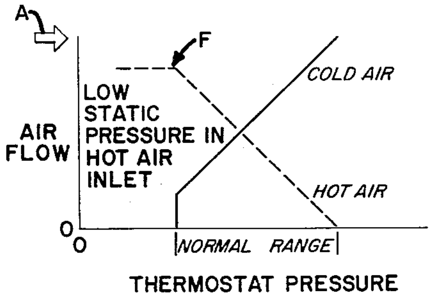

Fig. 10

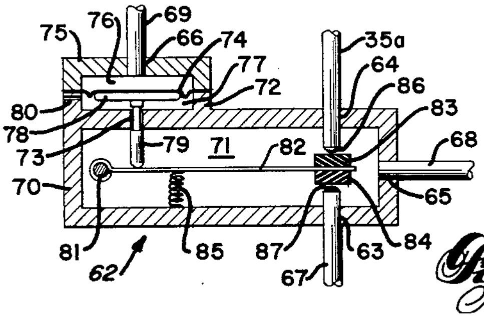

Fig. 9

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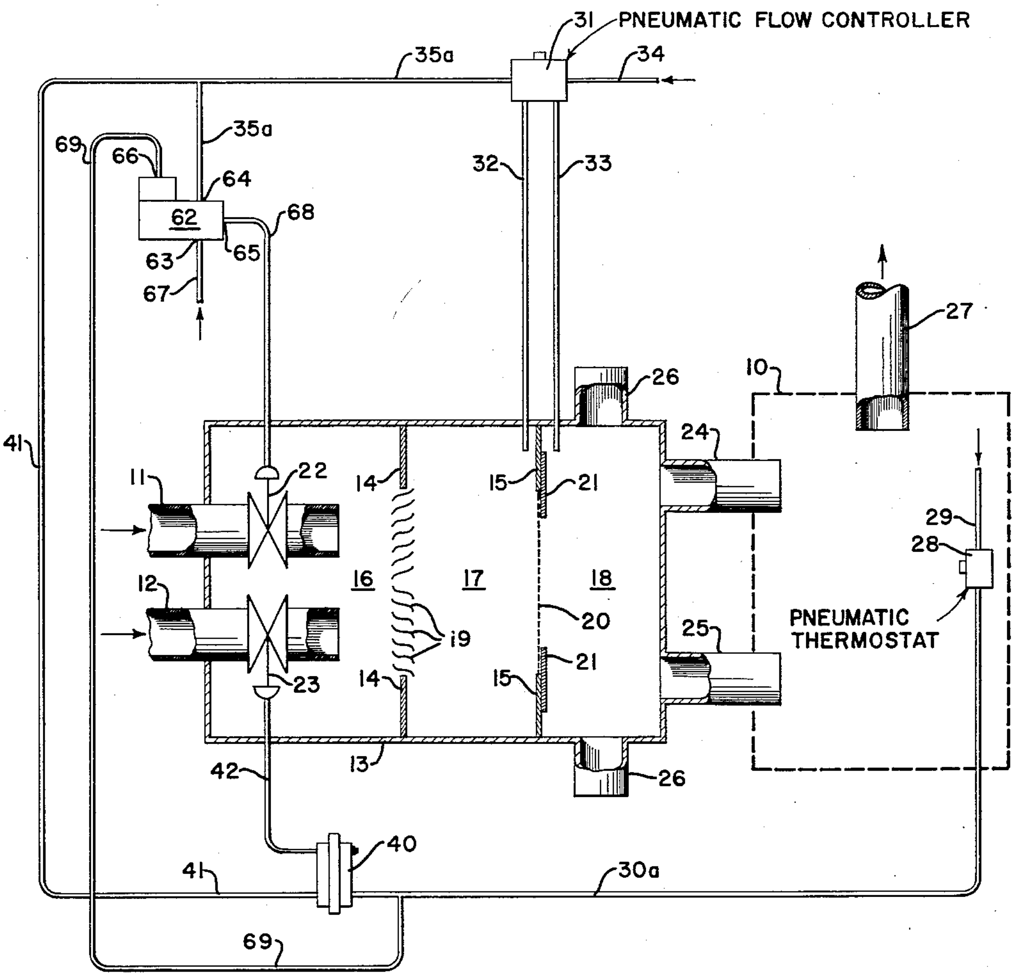

Fig. 11

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3,026,041
Patented Mar. 20, 1962

3,026,041

CONDITIONED AIR DISTRIBUTION

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Filed May 6, 1960, Ser. No. 27,411
3 Claims. (Cl. 236—13)

This invention relates to air conditioning systems and more particularly to a method and apparatus for automatic regulation of room temperature and inlet volume of air flow in a two stream air conditioning system.

Air conditioning systems employing two separate streams of air, hot and cold, are well known in the art. See, for example, U.S. Patent 2,729,429. Such air conditioning systems operate by providing separate streams of air which are distributed throughout a building for blending prior to discharge into the rooms of the building. One of these streams is maintained at a temperature substantially above the temperature which it is desired to maintain within the rooms. The other stream is maintained at a temperature which is substantially below the temperature which it is desired to maintain in the rooms. By independently throttling the two streams, a resultant blended stream of conditioned air can be provided for discharge into the rooms at a blended temperature which will maintain the desired conditions within the rooms of the building. Good ventilation practice dictates that the conditioned air should be supplied to the individual rooms at a substantially constant volume of flow.

For a clear understanding of the present invention and of problems presented by two stream conditioned air systems, reference should be had to the accompanying drawings in which:

FIGURE 1 is a schematic illustration of a prior art mixer box having automatic controls suitable for normal operation of two-stream air conditioning systems;

FIGURE 2 is a graphical representation of the normal operation of the mixer box illustrated in FIGURE 1;

FIGURE 3 is a graphical illustration of one defect which is inherent in the operation of the prior art mixer box shown in FIGURE 1;

FIGURE 4 is a schematic illustration of a mixer box according to one embodiment of the present invention which offsets the inherent defect illustrated in FIGURE 3;

FIGURE 5 is a cross-section illustration of a shuttle valve which is shown schematically in FIGURE 4;

FIGURE 6 is a graphical illustration showing the results achieved by operation of the mixer box of FIGURE 4;

FIGURE 7 is a graphical illustration showing another defect which is inherent in the operation of the prior art mixer box of FIGURE 1;

FIGURE 8 is a schematic illustration of an alternative embodiment of the present invention which offsets the inherent defect illustrated in FIGURE 7;

FIGURE 9 is a cross-section illustration of a shuttle valve which is illustrated schematically in FIGURE 8;

FIGURE 10 is a graphical illustration showing the results achieved by the operation of the mixer box of FIGURE 8; and

FIGURE 11 is a schematic illustration of a preferred embodiment of the mixer box of this invention including the features already shown in FIGURES 4 and 8.

Every room, group of rooms or portion of a single room in a building may be considered as "a relatively confined zone" for the purposes of air conditioning. A continuous supply of conditioned air is introduced into each room (control zone) and a corresponding quantity of air is removed from the room (control zone) for dissipation or reconditioning and recirculation.

As shown in FIGURE 1, an individual room or control zone is indicated by the numeral **10**.

Two streams of conditioned air are provided throughout the building and are represented by the numerals **11** (cold air inlet) and **12** (hot air inlet). The two air inlets communicate with a mixer box **13** which is shown in cross-section. A pair of partitions **14**, **15** extend across the cavity of the mixer box **13** and divided the cavity into an inlet blending chamber **16**, a mixing chamber **17** and a distribution chamber **18**. The partition **14** separates the inlet blending chamber **16** from the mixing chamber **17** and has a plurality of directional mixing vanes **19** which create some turbulence as air passes through the portion **14** to provide a uniformly mixed stream of blended air. The partition **15** separates the mixing chamber **17** from the distribution chamber **18** and has a perforate plate **20** through which air may experience streamline flow. The perforate plate **20** may be a screen, perforated sheet, netting, mesh and the like. Imperforate plates **21** are provided in a slidable mounting in which they may be extended or retracted to regulate the cross-sectional area of the perforate plate **20** to regulate the flow of air therethrough.

A pair of pneumatically controlled valves **22**, **23** is provided in the cold air inlet **11** and the hot air inlet **12** respectively to throttle the flows of air issuing into the inlet blending chamber **16**. Air is discharged from the inlets **11** and **12** into the inlet blending chamber **16** whence it passes between the vanes **19** for uniformity of mixing within the mixing chamber **17**. Uniformly blended air passes through the perforate plate **20** into the distribution chamber **18** whence it is discharged into the control zone **10** through conduits **24**, **25**. Additional conduits **26** may be provided to discharge additional air to other rooms or to different locations of the same room. The entire air discharge from the distribution chamber **18** enters the "control zone" albeit several different "rooms" may receive the discharge.

An exit conduit **27** is provided to withdraw air from the control zone **10** for dissipation or reconditioning and recirculation.

A pneumatic thermostat **28** is maintained within the control zone **10** for continuous observation of the temperature therein. A supply stream of pressurized air is introduced into the thermostat **28** through a supply conduit **29**. The thermostat **28** regulates the pressure of the supply air, usually by bleeding a portion of the air, according to the deviation of the actual temperature within the control zone **10** from a predetermined temperature setting of the thermostat **28**. Thus a temperature regulated pressure of the throttled supply air is introduced into a conduit **30** which communicates with and operates the pneumatically controlled valve **23** in the hot air inlet **12**. Normally the supply air in the conduit **29** is maintained at a pressure of about 17 to 20 pounds per square inch. The temperature regulated pressure in the conduit **30** normally has a range of about 5 pounds per square inch, that is, from about 8 pounds per square inch to about 13 pounds per square inch. Hereinafter any conduit which confines the temperature regulated pressure and which extends between the thermostat **28** and any other element in the system will be identified as the thermostat conduit.

When the temperature within the control zone **10** is below the predetermined value, the temperature regulated pressure in the thermostat conduit **30** is reduced; when the temperature in the control zone **10** is above the predetermined value, the temperature regulated pressure in the thermostat conduit **30** is increased. The pneumatically responsive valve **23** operates to be opened when confronted with relatively low pressures and to be closed when confronted with relatively high pressures. Thus the amount of hot air issuing from hot air inlet **12** into the inlet blending chamber **16** is controlled in response to deviations of the actual temperature within the control zone 10 from a predetermined value.

A substantially constant volume discharge of blended conditioned air into the distribution chamber 18 is achieved by means of a pneumatic flow controller such as a differential pressure regulator 31. It will be observed that the perforate plate 20 in the baffle 15 serves as a flow measuring orifice. A pair of static pressure sensing taps 32, 33 is provided to observe the static pressure on each side of the baffle 15 and to transmit these static pressures to the differential pressure regulator 31. So long as a constant volume of air passes through the perforate plate 20, a predetermined constant pressure differential will exist between the pressure taps 32, 33. If the volume of air passing through the perforate plate 20 exceeds the predetermined value, the pressure differential existing between the pressure taps 32, 33 will increase. Similarly if the volume of air passing through the perforate plate 20 is less than the predetermined value, the pressure differential existing between the pressure taps 32, 33 will decrease. Accordingly the differential pressure regulator 31 serves to regulate a supply of pressurized air from a conduit 34, usually by bleeding a portion of the air, in response to deviations in the observed differential pressure from a predetermined constant value. Thus a flow regulated pressure of the throttled supply air is introduced into a conduit 35. Hereinafter any conduit which confines the flow regulated pressure and which extends between the differential pressure regulator 31 and any other element in the system will be identified as a pressure regulator conduit. If the observed differential pressure is greater than the predetermined value, the flow regulated pressure maintained in the pressure regulated conduit 35 increases. If the observed differential pressure is less than the predetermined value, the flow regulated pressure maintained in the pressure regulator conduit 35 is decreased.

The perforate plate 20 serves principally to promote a uniform flow of air from the mixing chamber 17 to the distribution chamber in order that the pressure differential existing between the chambers 17 and 18 may be accurately measured by suitable pressure differential measuring apparatus. The pressure regulator conduit 35 communicates with and operates the pneumatically controlled valve 22 in the cold air inlet 11. Normally the range of the flow regulated pressure maintained within the pressure regulator conduit 35 will be about 5 pounds per square inch, that is, from about 3 pounds per square inch to about 8 pounds per square inch. High air pressures in the pressure regulator conduit 35 tend to close the pneumatically controlled valve 22. Low air pressures in the pressure regulator conduit 35 tend to open the pneumatically controlled valve 22.

It is thus apparent that the flow of hot air from the hot air inlet 12 is regulated in response to the thermostat 28 in such manner that greater quantities of hot air will be discharged into the inlet blending chamber 16 when the actual temperature in the control zone 10 is below the predetermined temperature setting. The amount of cold air discharged into the inlet blending chamber 16 from the cold air inlet 11 will be sufficient so that the combination of the hot air and cold air which passes through the perforate plate 20 is a predetermined volume.

The normal operation of the system illustrated in FIGURE 1 can be described by the graphical representation shown in FIGURE 2. The vertical axis represents the flow of air from each of the two inlets 11, 12. An arrow A indicates the predetermined constant volume of air which is desired in the control zone 10. The horizontal axis indicates the temperature regulated pressure (thermostat pressure) maintained within the temperature regulated conduit 30. It will be observed that increasing thermostat pressure results in a decreased volume of hot air entering into the inlet blending chamber 16. The amount of cold air discharged into the inlet blending chamber 16 is supplementarily dependent upon the amount of hot air and is such that the summation of the cold air and the hot air is equal to the predetermined constant volume which is indicated by the arrow A. The arrow B indicates the flow of hot air which is achieved when the pneumatically controlled valve 23 is fully opened with a normal static pressure being maintained in the hot air inlet 12. The arrow C indicates that there is no hot air admitted into the inlet blending chamber 16 when the pneumatically controlled valve 23 is completely closed, corresponding to a high temperature regulated pressure appearing within the conduit 30. Under normal operating conditions, the system illustrated in FIGURE 1 will perform entirely within the normal range indicated in FIGURE 2. That is, some quantity of air will be admitted into the inlet blending chamber 16 from each of the inlets 11 and 12.

The system illustrated in FIGURE 1 exhibits inherent defects in two circumstances:

Circumstance 1.—When the control zone 10 is cold and a high static pressure exists in the hot air inlet 12.

Circumstance 2.—When the control zone 10 is cold and a low static pressure exists in the hot air inlet 12.

According to the present invention, mixer box controls are presented which overcome the inherent defects in the two described circumstances. To offset circumstance 1, a shuttle valve is provided in the thermostat conduit which permits the differential pressure regulator to override the thermostat as the control parameter for the pneumatically controlled valve in the hot air inlet. To compensate for circumstance 2, a shuttle valve is provided in the pressure regulator conduit which causes closure of the pneumatically controlled valve in the cold air inlet in respose to pressurized supply air when the thermostat pressure falls below its normal operating range.

The principal object of this invention is to provide a mixer box and controls therefor which will automatically regulate the flow of air from a two-stream air conditioning system to maintain a predetermined temperature within a control zone while providing ventilation at a substantially constant volume rate.

A further object of this invention is to provide a mixer box and control system therefor to regulate the flow of air from a two-stream air conditioning system regardless of the static pressure fluctuations in the streams.

These and other objects and advantages of the present invention will become apparent from the following detailed description.

Circumstance 1.—When the control zone 10 is cold and a high static pressure exists in the hot air inlet 12.

Consider the system shown in FIGURE 1 when the control zone 10 is cold, i.e., at a temperature below the predetermined temperature. Decreased temperature regulated pressure in the thermostat conduit 30 will cause the pneumatically controlled valve 23 to move to fully open position. If, at this time, the static pressure within the hot air inlet 12 is excessive, it is possible that the hot air issuing into the inlet blending chamber 16 has a greater volume than the predetermined volume which is controlled by the differential pressure regulator 31. Accordingly the pressure taps 32, 33 will sense an excessive differential pressure; hence an increasing flow regulated pressure will appear in the pressure regulator conduit 35 to cause the pneumatically controlled valve 22 to close completely. The differential pressure regulator 31 at that point has fully compensated the dependent variable which it controls yet has not limited the volume of air flowing through the perforate plate 20 to the predetermined value. The result is as shown in FIGURE 3 where it appears from the arrow D that the flow of cold air has been terminated yet the total flow, representing exclusively hot air, exceeds the predetermined value (indicated by the arrow A) as shown by the shaded area **34**. Thus when circumstance 1 develops, an excessive volume of air is introduced into the control zone **10** through the conduits **24**, **25**.

The embodiment of this invention illustrated in FIGURE 4 avoids the difficulties just described with reference to circumstance 1. The essential elements of FIGURE 4 are the same as those illustrated in FIGURE 1 and corresponding numerals refer to corresponding elements.

A shuttle valve **40** is provided having two inlet connections and one outlet connection. A thermostat conduit **30***a* connects the thermostat **28** with one of the inlet connections of the shuttle valve **40**. A pressure regulator conduit **41** extends from the pressure regulator conduit **35** to the other inlet connection of the shuttle valve **40**. A pneumatic valve operating conduit **42** connects the outlet of the shuttle valve **40** with the pneumatically controlled valve **23**.

The shuttle valve **40** is more clearly illustrated in FIGURE 5. Essentially the shuttle valve **40** is formed from two casing halves **43** and **44** which are joined together by means of bolts **45**. A flexible diaphragm **46** separates the casing halves **43** and **44**. Cavities in each of the casing halves **43** and **44** form a right hand chamber **47** and a left hand chamber **48** separated by the flexible diaphragm **46**. A conduit **49** is provided in the casing half **43** for communication between the thermostat conduit **30***a* and the right hand chamber **47**. A conduit **50** is provided in the casing half **44** for communicating between the pressure regulator conduit **41** and the left hand chamber **48**. A conduit **51** extends through both of the casing halves **43**, **44** and communicates between the right hand chamber **47** and the pneumatic valve operating conduit **42**. A threaded needle adjustment screw **52** extends through the casing half **43** to provide an adjustable restriction in the conduit **51**. A conduit **53** is provided in the casing half **44** between the left hand chamber **48** and the pneumatic valve operating conduit **42**. A central boss **54**, **55** extends inwardly from each of the casing halves **43**, **44** respectively.

It will be apparent that the air pressure of the thermostat conduit **30***a* is presented in the right hand chamber **47** through the conduit **49** whereas the air pressure of the pressure regulator conduit **41** is presented in the left hand chamber **48** through the conduit **50**. Under normal operating conditions, the pressure in the right hand chamber **47** will exceed the pressure in the left hand chamber **48** and consequently the diaphragm **46** will be displaced to the left to cover the chamber openings of the conduits **50**, **53** which are presented in the left hand chamber **48** in the boss **55**. Accordingly the conduits **49**, **51** will be in communication with the right hand chamber **47** and the air pressure of the thermostat conduit **30***a* will be transmitted through the conduit **49**, the right hand chamber **47**, the conduit **51** to the pneumatic valve operating conduit **42**. In effect, under normal operating conditions, there is a direct conduit connection between the thermostat **28** and the pneumatically controlled valve **23** and hence the system shown in FIGURE 4 normally functions exactly as the system shown in FIGURE 1.

However when circumstance 1 is presented, i.e., the temperature within the control zone **10** is below the predetermined value and a high static pressure exists in the hot air inlet **12**, the inherent defect illustrated in FIGURE 3 is offset by the apparatus shown in FIGURE 4. The defect is offset in the following manner. Because of the low temperature existing in the control zone **10**, the air pressure in the thermostat conduit **30***a* is a low value tending to open the pneumatically controlled valve **23** to a maximum open position. Similarly the air pressure in the pressure regulator conduit **35** is a maximum tending to close the pneumatically operated valve **22**. Once the pneumatically operated valve **22** is fully closed, the differential pressure regulator **31** will continue to increase the air pressure in the pressure regulator conduit **35** in an effort to correct for the excessive differential pressure which is being sensed through the pressure taps **32**, **33**. The further increasing pressure is transmitted through the conduit **41** into the shuttle valve **40** through the conduit **50**. When the pressure in the left hand chamber **48** exceeds the pressure in the right hand chamber **47**, the diaphragm **46** moves from left to right covering the boss **54** and opening the boss **55**. Thus the increased pressure from the conduit **41** is transmitted through the conduit **50** into the left hand chamber **48** through the conduit **53** to the pneumatic valve operating conduit **42** where it exerts a pressure against the pneumatically operated valve **23** tending to cause it to move toward a closed position until only the predetermined volume of air is issuing through the perforate plate **20**.

Normal operation is restored when the static pressure in the hot air inlet **12** is reduced to a normal value or when the temperature in the control zone **10** rises to a value closer to the predetermined value. If the static pressure in the hot air inlet **12** decreases to a normal value, the air issuing from the conduit **12** into the inlet blending chamber **16** will be less than the predetermined value and the air pressure in the pressure regulator conduits **35** and **41** will decrease to allow the diaphragm **46** to move against the boss **55** as in normal operation. Alternatively a closer approach to the predetermined temperature in the control zone **10** will result in an increase in the air pressure in the thermostat conduit **30***a* which will cause the diaphragm **46** to move against the boss **55** and at the same time exert a closing tendency through the pneumatic valve operating conduit **42** against the pneumatically operated valve **23**.

The correction achieved by the system illustrated in FIGURE 4 is shown graphically in FIGURE 6. When the flow of cold air has been terminated completely (see the arrow D), the shuttle valve **40** automatically switches the control parameter from the thermostat to the differential pressure regulator so that the desired volume of air, as indicated by the arrow A, is not exceeded.

A typical situation which might create circumstance 1 would be presented when an individual within the control zone **10** opens a window or a door in cold weather to allow a substantial quantity of cold air to enter the control zone **10** and create a decrease in the actual temperature therein. If this situation should develop at a time when an excessive static pressure appears in the hot air inlet **12**, circumstance 1 would be presented.

Circumstance 2.—When the control zone **10** is cold and a low static pressure exists in the hot air inlet **12**.

Referring once again to the apparatus shown in FIGURE 1, in this circumstance the thermostat **28** develops an increasing temperature regulated pressure in the thermostat conduit **30** causing the pneumatically operated valve **23** to open to a full position. Because of the inadequate static pressure in the hot air inlet **12**, less than the predetermined total volume of air is discharged from the hot air inlet **12** into the inlet blending chamber **16**. Accordingly the differential pressure regulator **31** reduces the flow regulated pressure in the pressure regulator conduit **35** causing the pneumatically operated valve **22** to move in an open position. As a result, a blend of air from the cold air inlet **11** and the hot air inlet **12** is introduced into the inlet blending chamber **16** and thence through the mixing chamber **17** to the distribution chamber **18** and into the control zone **10** despite the fact that the control zone **10** already is at a temperature below the predetermined value.

This condition is illustrated graphically in FIGURE 7 where the arrow E indicates the maximum flow of hot air attainable with a fully opened valve **23**. Because the value indicated by the arrow E is less than the predetermined value indicated by the arrow A, a quantity of cold air indicated by the shaded area **61** will enter the control zone **10**.

According to a further embodiment of the present invention as illustrated in FIGURE 8, the difficulties described as circumstance 2 can be obviated. The elements of the mixer box shown in FIGURE 8 are essentially the same as those shown in FIGURE 1. Corresponding numerals are employed to indicate corresponding elements.

The principal change is the provision of a shuttle valve 62 having two inlet ports 63, 64, one outlet port 65, and one control port 66. A source of supply air is introduced into a conduit 67 to the inlet port 63. The pressure regulator conduit 35*a* joins the differential pressure regulator 31 with the inlet port 64. A valve operating conduit 68 joins the outlet port 65 with the pneumatically operated valve 22. A shuttle valve operating conduit 69 connects the thermostat conduit 30 with the shuttle valve operating inlet port 66.

The shuttle valve 62 is more fully illustrated in FIGURE 9.

The valve 62 comprises a hollow casing 70 having an internal chamber 71 and the previously mentioned inlet ports 63, 64 and outlet port 65. An annular boss 72 is provided externally of the casing 70 surrounding a plunger port 73 which extends through the casing 70. A resilient diaphragm 74 is secured across the outer surface of the annular boss 72 by peripheral sealing of a cover plate 75. The diaphragm 74 comprises the common wall of two chambers 76 and 77 which are respectively a shuttle valve operating chamber 76 and a vent chamber 77. The shuttle valve operating port 66 appears in the cover plate 75. Secured to the diaphragm 74 is a flat metal plate 78 and, mounted normally thereto, an operating plunger 79 which extends through the plunger port 73. A bleed port 80, opening to the atmosphere, extends through the annular boss 72 from the vent chamber 77.

Within the shuttle valve chamber 71 and pivotally mounted about a pin 81 is a flapper 82 suitably formed from a flat piece of metal and having at its extreme end a pair of pads 83, 84 of rubber or similar resilient material. A normally compressed spring 85 is positioned with relation to the flapper 82 to exert a force tending to cause counterclockwise movement of the flapper 82 whereby the pad 83 covers the tip 86 of the pressure regulator conduit 35*a* and the pad 84 is displaced from the tip 87 of the supply air conduit 67. Opposing the counterclockwise force presented by the normally compressed spring 85 is the plunger 79 which bears against the flapper 82 exerting a clockwise force about the pivot pin 81. The force exerted by the plunger 79 is determined by the pressure maintained within the operating chamber 76, i.e., the pressure within the thermostat conduit 69.

Normally the pressure in the operating chamber 76 is sufficient to cause the plunger 79 to overcome the resiliency of the normally compressed spring 85 whereby, under normal conditions, the pad 84 is compressed against the tip 87 of the supply air conduit 67 so that a direct flow passageway is provided from the pressure regulator conduit 35*a* through its tip 86 and into the pneumatic controlled valve operating conduit 68. When the temperature regulated pressure in the thermostat conduit 69 falls below a predetermined value, the resilient spring 85 causes counterclockwise movement of the flapper 82 whereby the supply air conduit 67 is free to introduce its pressure directly into the conduit 68. The pressure of the air in the supply conduit 67 is at all times in excess of that appearing in the pressure regulator conduit 35*a*. Under normal conditions the supply air conduit pressure will be from about 17 to 20 pounds per square inch. The pressure in the flow regulated pressure regulator conduit 35*a* will have a range of about 5 pounds per square inch, for example from about 3 to about 8 pounds per square inch. Since the normal range of pressures in the thermostat conduits 30, 69 is from about 8 to 13 pounds per square inch, the resilient spring 85 produces counterclockwise movement of the flapper 82 only when the pressure in the operating chamber 76 falls below about 8 pounds per square inch. The spring tension of the spring 85 is adjusted to the lower pressure of the operating range of the pressures in the thermostat conduit 30.

Returning to FIGURE 8, it will be observed that the system operates satisfactorily under circumstance 2. That is, under normal conditions, the system shown in FIGURE 8 performs exactly as the system shown in FIGURE 1.

Where, however, the low pressure maintained in the thermostat conduit 30 results in a fully opened valve 23, that same low pressure will activate the shuttle valve 62 whereby the supply air from the conduit 67 will be introduced into the conduit 68 to operate the pneumatically controlled valve 22. By virtue of its normal pressure of 17 to 20 pounds per square inch, the pressure from the supply air conduit 67 will cause the pneumatically controlled valve 22 to close completely.

Accordingly the characteristics of the system illustrated in FIGURE 8 can be graphically represented as shown in FIGURE 10. When the temperature regulated pressure from the thermostat decreases to a value below its normal operating range, the pneumatically controlled valve 23 becomes fully opened and, with a constant static pressure existing in the hot air inlet 12, the resulting air flow through the hot air inlet 12 will be constant as shown by the arrow F. Because of the postulated low static pressure in the hot air inlet 12, the flow of air therefrom at fully opened position is less than the predetermined flow of air as indicated by the arrow A. Nevertheless, because the thermostatic pressure is below its normal range, the further inflow of cold air is prevented and exclusively hot air is introduced into the inlet blending chamber 16. Admittedly the total flow of air from the system shown in FIGURE 8 does not, in this one isolated circumstance, have a constant value.

A typical situation giving rise to the circumstance 2 occurs in the early morning in buildings which have been mantained at lower than normal temperatures throughout the preceding evening during which the building was relatively unoccupied. In the early morning, every room or control zone 10 presents a temperature below the predetermined value and accordingly every room or control zone requires substantial quantities of hot air until the predetermined temperature is attained. Because of the universal demand upon the hot air supply, certain periods of low duct pressure may occur in the hot air inlets 12 through the inability of the hot air supply system to provide the peak load requirements. Thus the system illustrated in FIGURE 8 compensates for a problem which occurs daily in the operation of dual duct air conditioning systems.

Having now described its elements the preferred embodiment of the present invention may now be quickly illustrated by reference to FIGURE 11. The apparatus shown in FIGURE 11 embodies that previously shown in FIGURES 4 and 8. Corresponding numerals are employed to indicate corresponding elements.

As shown in FIGURE 11, both the shuttle valve 40 and the shuttle valve 62 are included in the preferred embodiment. The system shown in FIGURE 11 operates exactly, with respect to the shuttle valve 40, as the system illustrated in FIGURE 4. The system, with respect to the shuttle valve 62, operates exactly as that shown in FIGURE 8. The conduit 30*a* joins the thermostat 28 with the shuttle valve 40. In the preferred embodiment, the shuttle valve operating conduit 69 joins the thermostat conduit 30*a* with the operating port 66 of the shuttle valve 62. Similarly the pressure regulator conduit conduit 35*a* joins the differential pressure regulator 31 with the inlet port 64 of the shuttle valve 62. In the preferred embodiment the pressure regulator conduit 41 joins the pressure regulator conduit 35*a* with the inlet port of the shuttle valve 40.

According to the provisions of the patent statutes, I have explained the principle, preferred embodiment and mode of operation of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. In an air conditioning mixing and distributing box having a hot air inlet, a cold air inlet and at least one outlet conduit for discharging a blended stream of conditioned air into a relatively confined zone, a fluid pressure operated valve in each of said inlet conduits, a source of supply air under pressure, flow responsive means adapted to control the pressure of a first supply air source as a flow regulated pressure in accordance with the flow rate of said blended air stream, temperature responsive means within said relatively confined zone adapted to control the pressure of a second supply air source as a temperature regulated pressure in accordance with the temperature existing within said relatively confined zone, shuttle valve means having two fluid inlets and one fluid outlet adapted to communicate the said fluid outlet with that fluid inlet having the greater static pressure, conduit means communicating the said temperature regulated pressure and the said flow regulated pressure respectively to the said two fluid inlets and for connecting the said fluid outlet to the said fluid pressure operated valve in the said hot air inlet, and conduit means communicating said flow regulated pressure to said fluid operated valve in said cold air inlet.

2. In an air conditioning mixing and distributing box having a hot air inlet, a cold air inlet and at least one outlet conduit for discharging a blended stream of conditioned air into a relatively confined zone, a fluid pressure operated valve in each of said inlet conduits, a source of supply air under pressure, flow responsive means adapted to control the pressure of a first supply air source as a flow regulates pressure in accordance with the flow rate of said blended air stream, temperature responsive means within said relatively confined zone adapted to control the pressure of a second supply air source as a temperature regulated pressure in accordance with the temperature existing within said relatively confined zone, conduit means communicating the said temperature regulated pressure to the said fluid pressure operated valve in the said hot air inlet, shuttle valve means having two inlet ports and one outlet port, means within said shuttle valve means responsive to the pressure of said temperature regulated pressure to communicate said outlet port with only one of said inlet ports, conduit means connecting a third supply air source to one of said inlet ports and communicating said flow regulated pressure to the other of said fluid inlet ports and for connecting said outlet port to said fluid operated valve in said cold air inlet.

3. In an air conditioning mixing and distributing box having a hot air inlet, a cold air inlet and at least one outlet conduit for discharging a blended stream of conditioned air into a relatively confined zone, a fluid pressure operated valve in each of said inlet conduits, a source of supply air under pressure, flow responsive means adapted to control the pressure of a first supply air source as a flow regulated pressure in accordance with the flow rate of said blended air stream, temperature responsive means within said relatively confined zone adapted to control the pressure of a second supply air source as a temperature regulated pressure in accordance with the temperature existing within said relatively confined zone, first shuttle valve means having two fluid inlets and one fluid outlet adapted to communicate the said fluid outlet with that fluid inlet having the greater static pressure, conduit means communicating the said temperature regulated pressure and the said flow regulated pressure respectively to the said two fluid inlets and for connecting the said fluid outlet to the said fluid pressure operated valve in the said hot air inlet, second shuttle valve means having two inlet ports and one outlet port, means within said second shuttle valve means responsive to the pressure of said temperature regulated pressure to communicate said outlet port with only one of said inlet ports, conduit means connecting a third supply air source to one of said inlet ports and communicating said flow regulated pressure to the other of said fluid inlet ports and for connecting said outlet port to said fluid operated valve in said cold air inlet.

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Disclaimer

3,026,041.—*Arthur P. Jentoft*, Wexford, Pa. CONDITIONED AIR DISTRIBUTION. Patent dated Mar. 20, 1962. Disclaimer filed Sept. 13, 1962, by the assignee, *H. H. Robertson Company.*

Hereby enters this disclaimer to claim 1 of said patent.

[*Official Gazette October 23, 1962.*]