April 3, 1956 EL ROY J. KRAFT 2,740,587

THERMOSTATICALLY CONTROLLED AIR BLENDER

Filed Dec. 20, 1951 3 Sheets-Sheet 1

Fig. 1

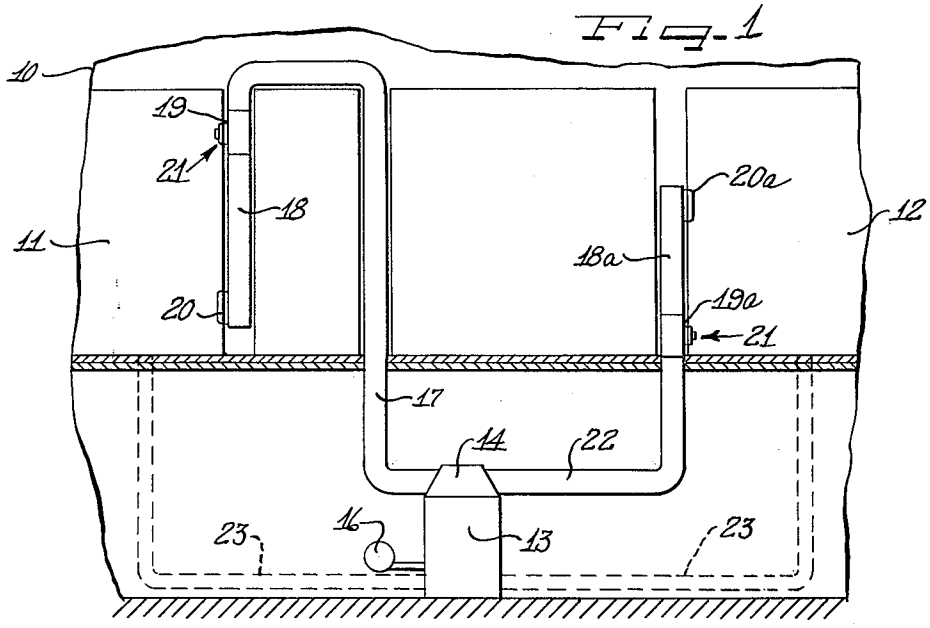


Fig. 3

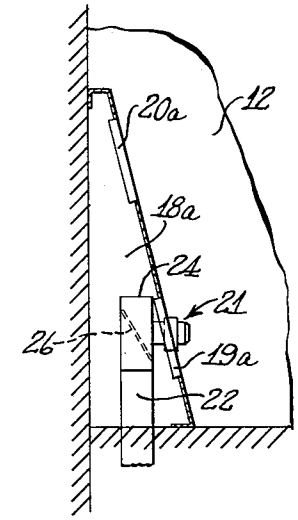
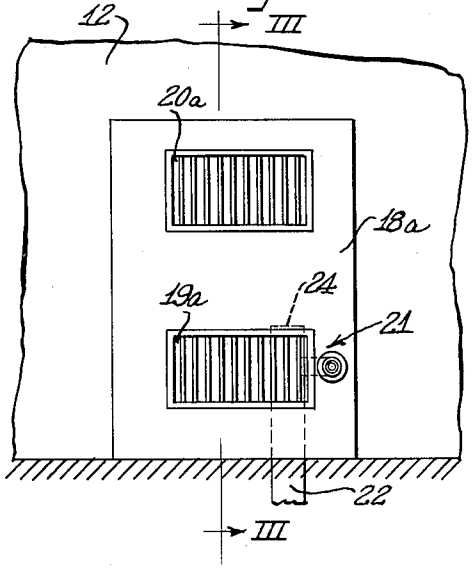


Fig. 2



Inventor

Elroy J. Kraft

by Lilly, Sherman, Mecum, Gass & Simpson Attys

April 3, 1956 EL ROY J. KRAFT 2,740,587

THERMOSTATICALLY CONTROLLED AIR BLENDER

Filed Dec. 20, 1951 3 Sheets-Sheet 2

Fig. 4

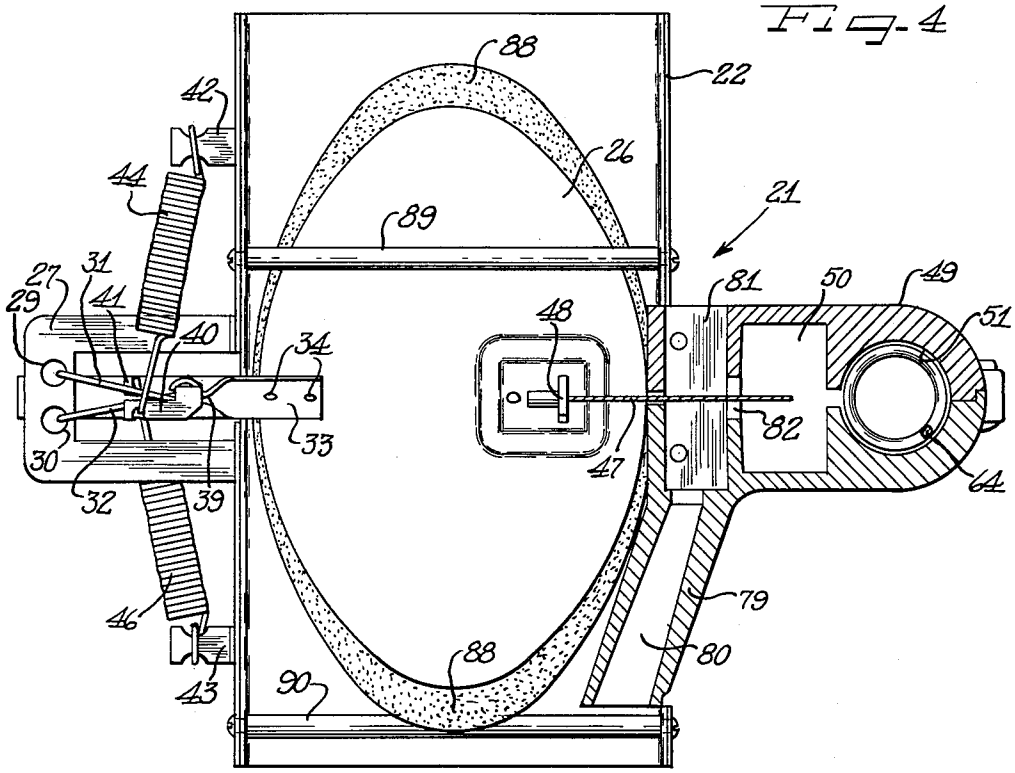
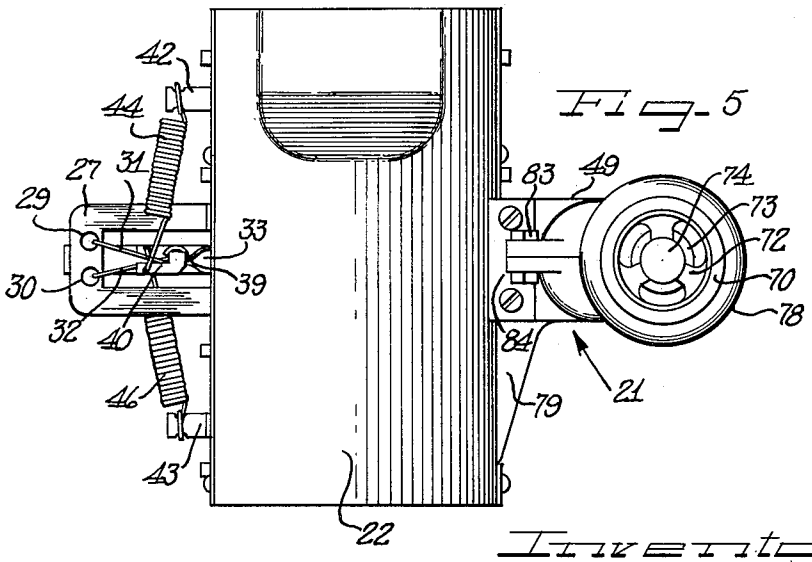


Fig. 5



Inventor

Elroy J. Kraft

by Kill, Sherman, Meroni, Gross & Simpson Attys

April 3, 1956 EL ROY J. KRAFT 2,740,587

THERMOSTATICALLY CONTROLLED AIR BLENDER

Filed Dec. 20, 1951 3 Sheets-Sheet 3

Fig. 6

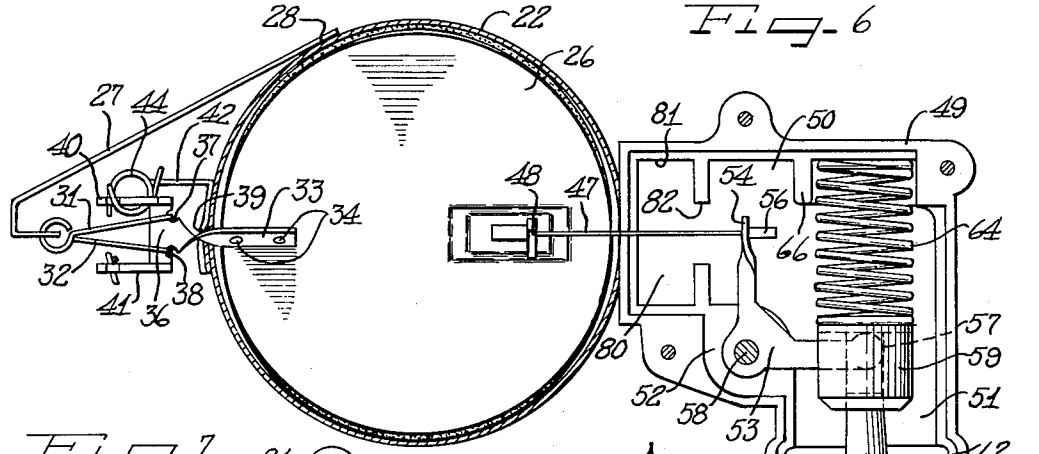
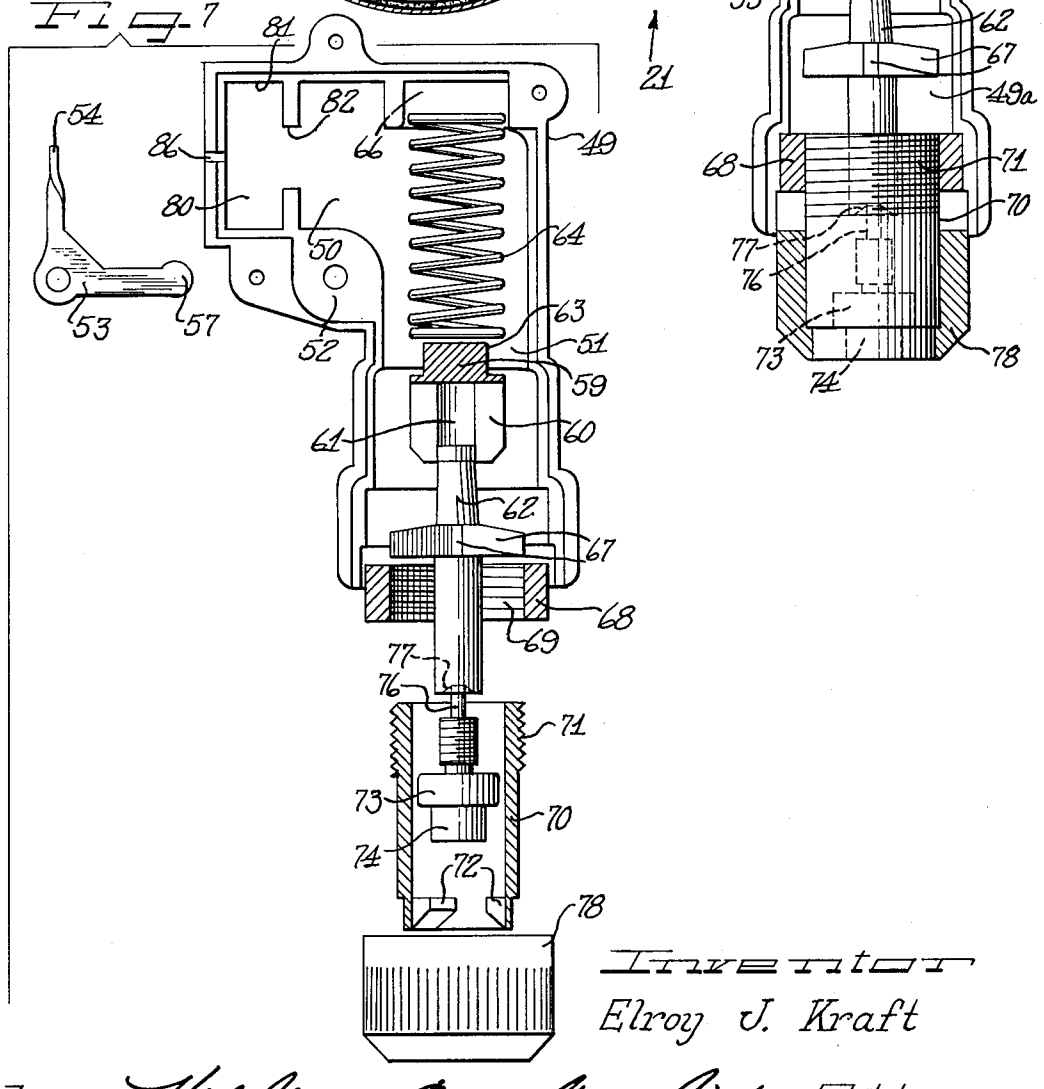


Fig. 7



Inventor
Elroy J. Kraft

by Kill, Sherman, Morsell, Clark & Simpson Attys

United States Patent Office

2,740,587

Patented Apr. 3, 1956

2,740,587

THERMOSTATICALLY CONTROLLED AIR BLENDER

El Roy J. Kraft, Des Plaines, Ill., assignor to The Dole Valve Company, Chicago, Ill., a corporation of Illinois

Application December 20, 1951, Serial No. 262,594

2 Claims. (Cl. 237—2)

This invention relates generally to ventilating apparatus and more particularly to a ventilating system of the type including a blending enclosure to receive the controlled expansion of pressurized temperature conditioned air whereby a flow of air into the blending apparatus from a ventilated space in which the blending apparatus is located is induced for mixture with the pressurized temperature conditioned expanded air prior to exiting from the blending apparatus into the space being ventilated. This invention further relates to improved thermostatic control means for regulating the expansion of the pressurized temperature conditioned air into the blending apparatus.

According to the general principles of the present invention, a supply of ventilating air is temperature conditioned and pressurized for distribution to one or more spaces to be ventilated. In order to improve the overall efficiency of the temperature conditioning and air distribution system, it may be desirable to temperature condition the air by imparting thereto a considerable quantity of thermal energy in excess of the temperature level at which the supply of air could be directed into an occupied space to be ventilated without subjecting the occupants of the space to a discharge flow exceeding normal comfort levels. It is further desirable to pressurize the temperature conditioned air to a considerable extent so as to facilitate the efficient distribution of temperature conditioned air through small sized ducts, thereby avoiding unnecessary thermal losses and unnecessary flow losses.

There is provided by the present invention a blending apparatus comprising an enclosure adapted to be placed in a space to be ventilated and having at least a pair of spaced openings in one wall thereof placing the interior of the enclosure in communication with the space to be ventilated. A duct carrying the pressurized temperature conditioned air extends into the blending apparatus enclosure and is provided with an outlet adjacent one of the openings and projecting towards the other of the openings. The expansion of pressurized temperature conditioned air from the duct in the enclosure is selectively controlled by the provision of a damper or shutter device located in the duct outlet. Thus, as expansion of the pressurized temperature conditioned air occurs, the resultant high velocity low pressure flow of air into the enclosure will induce the flow of air through the first opening from the space being ventilated whereupon such air will be thoroughly mixed and blended within the enclosure. The mixed and blended air is then discharged through the other opening of the enclosure into the space being ventilated.

This invention further contemplates the provision of an improved thermostatic control device arranged to regulate the damper or shutter controlling the expansion of pressurized temperature conditioned air into the blending chamber in response to temperature variations in the space being ventilated. To effect this end, a casing having a first passage housing a shutter actuator is positioned adjacent the duct outlet. The casing is provided with a

second passage intersecting the first passage and also intersecting one wall of the blending apparatus or blending chamber, thereby placing the casing passages in communication with the space being ventilated. A crank pivotally connected to the casing has a first arm projecting into the first passage and connected to the damper or shutter actuator and a second arm projects into the second passage. A thermostat is located in the second passage and is connected to the second arm. The casing further includes means to place the first passage in communication with the duct fluid, the first passage having an outlet opening into the blending chamber whereupon flow of duct fluid through such outlet will induce the flow of space temperatured air through the second passage past the thermostat, thereby to control the damper or shutter thermostatically.

It is an object of the present invention to provide a method of and apparatus for distributing temperature conditioned air to a ventilated space by a thermostatically regulated blending apparatus.

Another object of the present invention is to provide an improved blending apparatus for blending high temperature high pressure fluid with fluid from an adjacent enclosure.

A further object of the present invention is to provide an improved mechanism for regulating an angularly displaceable shutter by means of a thermostat located remotely from the shutter.

Many other features, advantages and additional objects of the present invention will become manifest upon making reference to the detailed description which follows and the accompanying sheets of drawings which show a preferred structural embodiment incorporating the principles of the present invention and by means of which the steps of the method disclosed herein may be practiced.

On the drawings:

Figure 1 is a somewhat schematic view showing a temperature conditioning and air distribution system incorporating the principles of the present invention and by means of which the method disclosed herein may be practiced;

Figure 2 is a fragmentary elevational view of a blending chamber provided in accordance with the principles of the present invention;

Figure 3 is a fragmentary cross-sectional view taken substantially on line III—III of Fig. 2;

Figure 4 is a cross-sectional view with parts shown in elevation and with parts removed showing additional details of construction of the thermostatically controlled shutter mechanism employed in the blending apparatus of Figures 2 and 3;

Figure 5 is a somewhat reduced elevational view of the structure shown in Figure 4;

Figure 6 is a cross-sectional plan view showing additional details of construction of the structure shown in Figures 4 and 5; and

Figure 7 is an exploded view of the control device shown in Figure 6 with parts shown in section.

As shown on the drawings:

In Figure 1 is shown schematically a temperature conditioning air distribution system embodying the principles of the present invention. An enclosure 10 is provided with a plurality of spaces to be ventilated including a space 11 and a space 12. A temperature conditioning unit or heat exchanger by way of illustrative structural embodiment takes the form of a furnace 13 having a plenum chamber 14. The furnace 13 is provided with a pressurizing means such as a blower 16 so that pressurized temperature conditioned air may be furnished to the plenum chamber 14.

A duct 17 leads from the plenum chamber 14 to a blending chamber 18 having a pair of spaced apart open-

ings in one wall thereof communicating with the space 11. The uppermost opening is indicated at 19 and comprises an inlet for the blending chamber 18 while the lowermost opening is indicated at 20 and comprises an outlet for the blending chamber 18. A flow control mechanism indicated generally at 21 is provided to regulate the expansion of pressurized temperature conditioned air from the duct 17 into the blending chamber 18.

A duct 22 leads from the plenum chamber 14 and communicates with a blending chamber 18*a* having a pair of spaced openings communicating with the space 12, the lowermost opening indicated at 19*a* and comprising an inlet for the blending chamber 18*a* while the uppermost opening is indicated at 20*a* and comprises an outlet for the blending chamber 18*a*. A flow control mechanism indicated generally at 21 is also provided to regulate the expansion of pressurized temperature conditioned air from the duct 22 into the blending chamber 18*a*.

If desired, the usual cold air returns indicated at 23 may be extended between the spaces 11 and 12 and the furnace 13.

The structural details of the blending chambers 18 and 18*a* shown more or less schematically in Figure 1 may be more clearly understood upon making reference to Figures 2 and 3 wherein is shown an illustrative structural embodiment of a typical blending chamber provided in accordance with the principles of the present invention. For the sake of convenience and clarity of understanding, it will be assumed that the blending chamber of Figures 2 and 3 corresponds with the blending chamber 18*a* and similar reference numerals will be applied to the structure of Figures 2 and 3. Thus, it will be noted that the blending chamber 18*a* comprises an enclosure having a pair of spaced openings 19*a* and 20*a* in one wall thereof. The duct 22 extends into the blending chamber 18*a* and is provided with an outlet 24 located adjacent the opening 19*a* and arranged to direct fluid into the enclosure comprising the blending chamber 18*a* in the general direction of the outlet 20*a*. A damper or shutter 26 is provided in the outlet 24 of the duct 22 to regulate the expansion of pressurized temperature conditioned air into the blending chamber 18*a*.

In order to improve the overall efficiency of the temperature conditioning and air distribution system, it may be desirable to supply ventilating air which is heated to a relatively high temperature level and pressurized to a relatively high pressure level. By so doing, the distribution ducts employed in the system may be greatly reduced in size thereby minimizing flow losses and thermal losses which would otherwise occur in a conventional temperature conditioning and air distribution system wherein the ventilating air is heated to relatively low temperatures and pressurized to relatively low pressures. Under such conditions, however, it will be apparent that the ventilating air cannot be expanded directly into the space to be ventilated without subjecting the occupants of the space to uncomfortable blasts of ventilating air heated to a temperature above normal comfort levels.

According to the principles of the present invention, the pressurized temperature conditioned air expanded from the duct 22 at the outlet 24 under the regulation of the shutter 26 produces a high velocity low pressure flow into the blending chamber 18*a* which tends to induce the flow of air from the space 12 through the inlet opening 19*a* whereupon the air from the space 12 and the expanded air from the duct 22 will be thoroughly mixed and blended within the blending chamber 18*a* and will subsequently pass out through the outlet opening 20*a*. The mixed and blended air emanating from the outlet opening 20*a* will be at a temperature level consonant with the comfort requirements of the space 12 and will also move at a reduced velocity so as to minimize the possibilities of an uncomfortable air blast.

The present invention further contemplates the regulation and control of the expansion of air from the duct 22 in response to temperature variations within the space 12, such regulation and control being effected by means of the flow control mechanism indicated generally at 21.

Referring now more particularly to Figures 4–7 in connection with Figures 2 and 3, it will be noted that the duct 22 has assembled therewith a bracket 27 which may be secured to the duct 22 in firm assembly by any conventional means, for example, spot welding as at 28. The bracket 27 is provided with a support section having a pair of spaced apertures 29 and 30 each seating the looped end of a suspension member indicated at 31 and 32 respectively.

A retainer 33 is firmly connected to the shutter 26 by a pair of fasteners 34 and includes an arm portion 36 arranged to extend through a plane parallel to a plane intersecting both of the apertures 29 and 30 in the support section of the bracket 27. The arm 36 has a pair of spaced apart recesses 37 and 38 which receive the opposite looped ends of the suspension members 31 and 32, respectively.

The retainer 33 is twisted as at 39 so that when the shutter 26 is in one predetermined position, the axis of the arm 36 and the axis of the apertures 29 and 30 will be relatively angularly offset thereby to twist the suspension members 31 and 32 and torsionally loading the shutter 26.

The retainer 33 further includes a pair of arms 40 and 41 which project from opposite ends of the arm 36 and which are arranged in generally parallel relationship with respect to one another. A pair of clips 42 and 43 are carried by the duct 22 and lie in spaced relationship to the arms 40 and 41 so that a pair of control springs 44 and 46 may be extended between the arm 40 and the clip 42 and between the arm 41 and the clip 43, respectively.

At the opposite side of the shutter 26, a tensioning cord 47 is firmly secured as at 48 and extends through the wall of the duct 22. The suspension means supporting the shutter 26 torsionally load the shutter 26 and the tensioning cord 47 is effective to translate variable tensions to the torsionally loaded shutter 26 thereby to control the relative angular displacement of the shutter 26 in the duct 22.

The flow control mechanism 21 includes a casing indicated generally at 49 having a first passage 50 coaxially aligned relative to the tensioning cord 47 so that one end of the tensioning cord 47 may be received thereby. The casing 49 further includes a second passage 51 which intersects the first passage 50. In the preferred structural embodiment herein shown, the second passage 51 is disposed at right angles to the first passage 50.

Adjacent the point of intersection of the passages 50 and 51 is provided a journaling means 52 seating a crank 53 having a first arm 54 projecting into the first passage 50 and being connected in firm assembly with the end of the tensioning cord 47 as at 56. The crank 53 is provided with a second arm 57 which projects into the second passage 51. A pivot pin 58 pivotally journals the crank 53 on the journaling portion 52 of the casing 49, thereby permitting selective angular displacement of the crank 53. It will be appreciated that the movement of the crank arms 54 and 57 throughout a limited range will be substantially linear with relationship to the respective passages 50 and 51, the angular disposition of the crank arms 54 and 57 being similar to the relative angular disposition of the first passage 50 and the second passage 51.

A retainer 59 is slotted as at 60 to receive the arm 57 and is also provided with a recess 61 extending therein into from one end to receive and seat the end of a spacer 62. The other end of the retainer 59 is provided with a neck 63 arranged to bottom one end of a coil spring 64 having its opposite end bottomed against the walls of the casing 49, a hollow boss 66 being provided at the end of the passage 51 to receive the end of the coil spring 64.

The spacer 62 comprises a generally cylindrical member having a plurality of radially extending circumferentially spaced fingers 67 arranged on a medial portion thereof to engage cylindrical side wall portions 49a in the second passage 51, thereby slidingly supporting the spacer 62 for reciprocatory movement.

A sleeve 68 internally threaded as at 69 is received in the second passage 51 and threadedly engages a tubular housing 70 having complemental thread portions 71. At one end of the housing 70 a plurality of radially inwardly extending circumferentially spaced lugs 72 are provided to abuttingly engage and seat an annular rib 73 formed on a thermal unit 74. The thermal unit 74 preferably comprises a thermostat of the type enclosing a mass of material which will change in volume during a transformation from one physical state to another in response to temperature variations, the relative changes in volume being utilized to effect the linear translation of a movable piston member 76 arranged to project out of one end of the thermal unit 74 for engagement with the spacer 62. The spacer 62 is recessed endwise as at 77 to seat the piston 76. A knurled adjusting knob 78 is firmly connected to the housing 70 and may be rotated in alternative direction to selectively vary the effective thermal range of the thermal unit 74 through the axial adjustment of the housing 70 relative to the casing 49.

The casing 49 is provided with a depending portion 79 having a third passage 80 which intersects the duct 22 and communicates with the duct fluid on the upstream side of the shutter 26. An outlet opening 81 communicating with the blending chamber 18a is provided for the third passage 80. The third passage 80 is also placed in communication with the first passage 50 by means of an aperture 82 so that flow of duct fluid through the third passage 80 into the blending chamber 18a by way of the outlet 81 will induce the flow of air from the first passage 50 through the aperture 82, thereby aspirating a flow of air through the second passage 51 past the thermal unit 74.

By virtue of the angular relationship between the first passage 50 and the second passage 51, the casing 49 is advantageously arranged with the second passage 51 intersecting the one wall of the blending chamber 18a so as to place the second passage 51 in communication with the air in the space 12. Thus, as air is aspirated through the passage 51, the thermal unit 74 will be subjected to changes in temperature occurring in the fluid within the space 12.

The coil spring 64, of course, operates as a control spring and normally urges the crank 53 in one direction, however, upon movement of the piston 76 in response to variations in temperature within the space 12, the crank 53 will be moved against the bias of the spring 64 thereby altering the tensioning force imparted to the torsionally suspended shutter by the tensioning cord 47. It will be understood that whenever the tensioning force on the tensioning cord 47 is varied, the torsional load on the shutter 26 will result in the shutter 26 assuming a predetermined position of equilibrium and any variation in the tensional force on the tensional cord 47 will upset such equilibrium so that the shutter will seek a new angular position corresponding to a new position of equilibrium. In this manner, tensional variations are imparted to the tensioning cord 47 in response to temperature variations within the space 12 so as to open and close the shutter 26 thereby controlling and regulating the expansion of the pressurized and temperature conditioned air from the duct 22 into the blending chamber 18.

In the preferred embodiment herein shown, the casing 49 is made in two separate halves which are connected together by a plurality of fasteners 83. The casing 49 may be attached in firm assembly with the duct 22 by means of a suitable bracket 84 and an aperture 86 is

provided through which the tensioning cord 47 may be passed.

As a matter of interest it may be noted that the shutter 26 employed in the present embodiment is of generally oval configuration and is somewhat angularly disposed within the duct 22. To facilitate closing action, the edges of the shutter 26 are provided with a strip of flexible material indicated at 88, for example, felt. A pair of spaced apart struts 89 and 90 are extended across the duct 22 to reinforce the duct structure in the vicinity of the flow control mechanism 21 and also serve as limit stops for the shutter 26.

Although various minor structural modifications might be suggested by those versed in the art to the preferred structural embodiment herein disclosed by way of illustrative example, it should be understood that I wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of my contribution to the art.

I claim as my invention:

1. A temperature conditioning system comprising a heat exchanger having a plenum chamber to receive pressurized temperature conditioned fluid, a space to be temperature conditioned, a housing in said space having a pair of spaced apart apertures in one wall thereof communicating with the fluid in said space, a duct between said plenum chamber and said housing, said duct having an outlet extending into said housing adjacent one of said apertures and directed toward the other of said apertures, a shutter in said duct, means to rotate said shutter including an actuator extending through one wall of said duct, a casing having a first passage receiving said actuator and a second passage intersecting said first passage, said second passage also intersecting said one wall of said housing, a crank pivoted on said casing having one arm in said first passage connected to said actuator and a second arm in said second passage, a thermostat in said second passage engaging said second arm to control said actuator thermostatically, said casing having a third passage intersecting said duct on the upstream side of said shutter and intersecting said first passage, said first passage having an outlet opening into said housing in registry with said third passage, whereby the flow of fluid from said duct through said outlet will induce a flow of fluid from said first passage thereby to aspirate fluid from said space through said second passage past said thermostat, the discharge of fluid from said duct into said housing operating to induce a flow of fluid from said space through said one aperture into said housing whereupon said induced flow of fluid will be mixed and blended with said duct fluid prior to discharge thereof through said other aperture into said space.

2. A fluid blending structure comprising a housing having a pair of spaced apart apertures in one wall thereof, a duct extending into said housing and having an outlet adjacent one of said apertures and directed towards the other of said apertures, an angularly adjustable shutter in said duct to control the flow of fluid therethrough, means to rotate said shutter including an actuator extending through one wall of said duct, a casing having a first passage receiving said actuator, and a second passage intersecting said first passage, said second passage also intersecting said one wall of said housing, a crank pivoted on said casing having one arm in said first passage connected to said actuator and a second arm in said second passage, a thermostat in said second passage engaging said second arm to control said actuator thermostatically, said casing having a third passage intersecting said duct on the upstream side of said shutter and intersecting said first passage, said first passage having an outlet opening into said housing and being in registry with said third passage, whereby the flow of fluid from said duct through said outlet will induce a flow of fluid from said first passage, thereby to aspirate fluid from exteriorly of said housing through said second passage past said ther-

mostat, the discharge of fluid from said duct into said housing operating to induce a flow of fluid from interiorly of said housing through said one aperture into said housing, whereupon said induced flow of fluid will be mixed with said fluid discharged from said duct prior to discharge through said other aperture into said space.

References Cited in the file of this patent

UNITED STATES PATENTS

1,296,968	Klein	Mar. 11, 1919
1,610,887	Ryan	Dec. 14, 1926
1,862,567	Fina	June 14, 1932
2,523,497	Copping	Sept. 26, 1950
2,523,499	Copping	Sept. 26, 1950
2,579,507	MacCracken	Dec. 25, 1951