Dec. 9, 1952 S. E. LYMAN 2,620,983

AIR CONDITIONING SYSTEM

Filed April 28, 1950 3 Sheets-Sheet 1

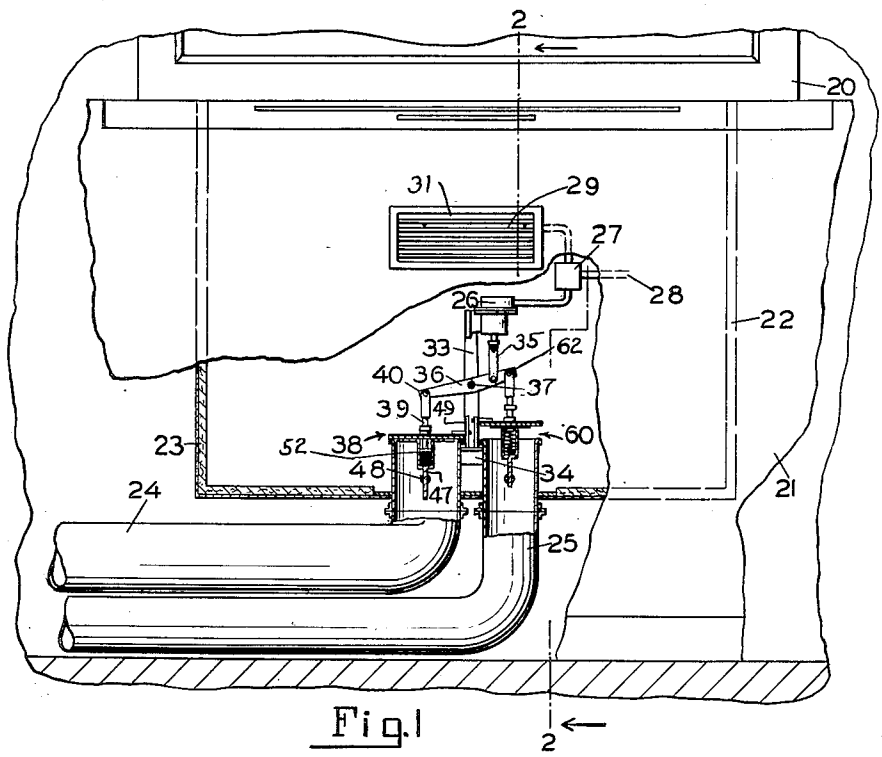


Fig. 1

Fig. 2

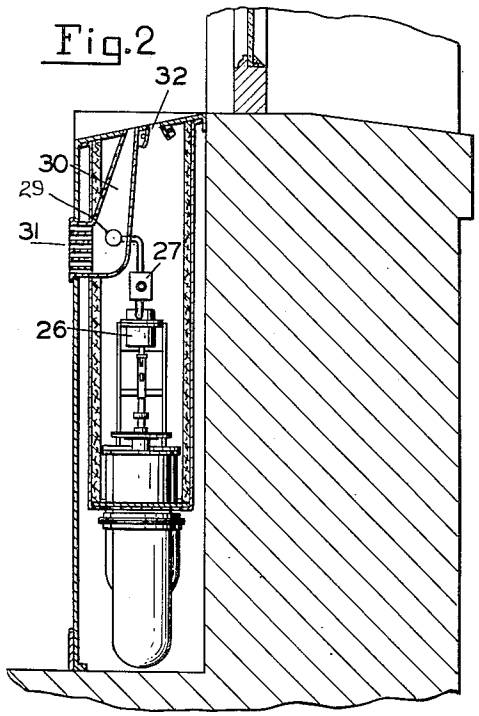
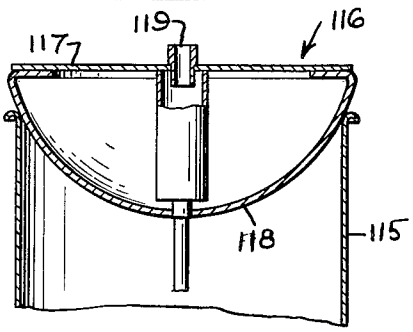


Fig. 3



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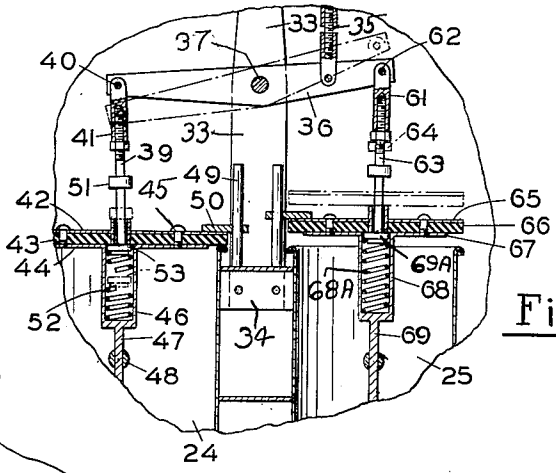


Fig.4

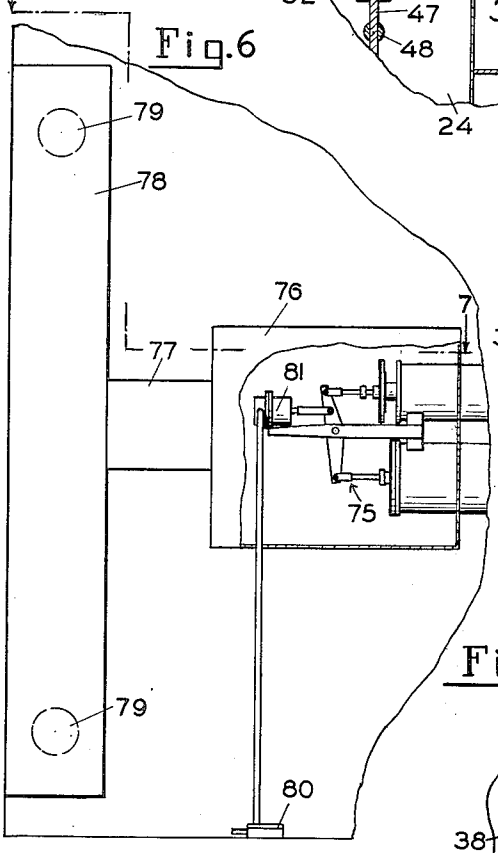


Fig.6

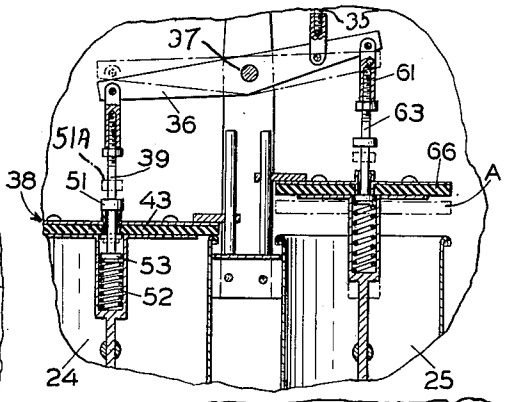


Fig.5

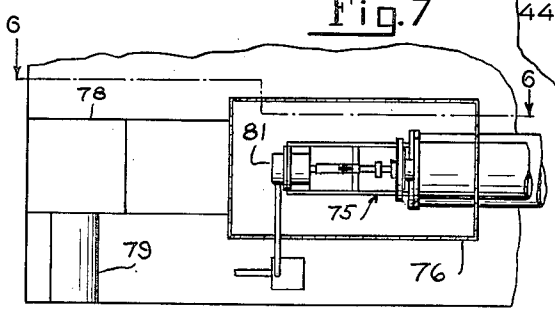


Fig.7

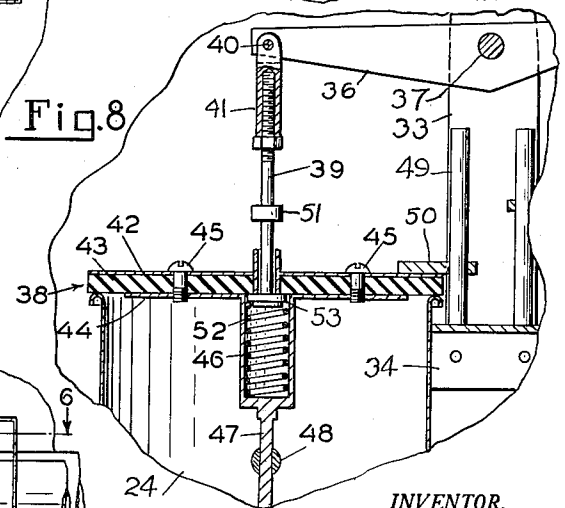


Fig.8

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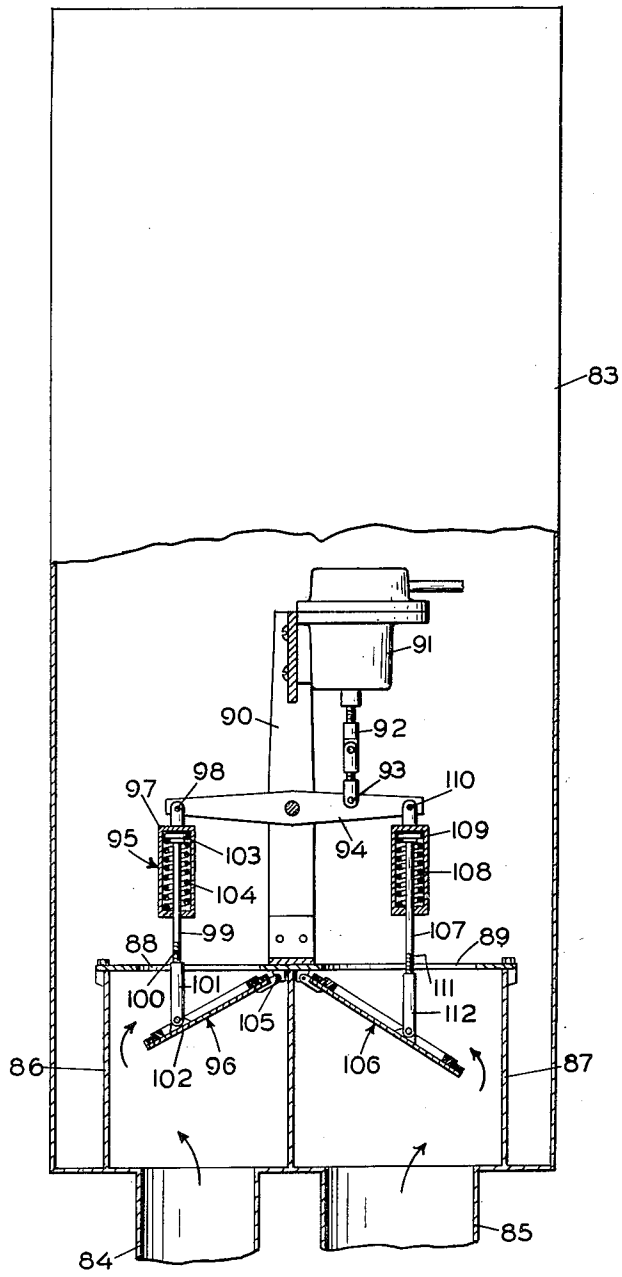


Fig. 9

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AIR CONDITIONING SYSTEM

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Application April 28, 1950, Serial No. 158,840

8 Claims. (Cl. 236—13)

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This invention relates to air conditioning apparatus and particularly to a regulating apparatus mixing conditioned air prior to its admission into the zone or the room.

One of the difficulties in prior practice, particularly where high pressure air systems are involved, has been objectionable noise and also the upset of conditions when the regulating means controlling the proportionate supply of warm and cold air from a pair of ducts changes the relationship between the amount admitted by each. This is especially true at the time when a closed valve is first opened after having been closed, the other valve being open. When a combination of two valves is used and one valve is entirely closed and then opened, the total amount of air fed by the two valves together must be controlled so that there is not a sudden and critical increase of total air supplied. If it is not controlled, the aforementioned undesirable noise and upset conditions will occur. One factor involved is the change in static and velocity head relationship when a closed valve is opened. This is especially the case where a relatively small supply pipe is controlled carrying air at a relatively high pressure. One of the requirements of an acceptable air conditioning apparatus, especially for places such as hotel rooms, auditoriums, etc., is that the noise created by the system be extremely low. Another requirement is that the amount of duct work and installation be as small as possible.

One of the objects of the invention is to provide an easily adjustable damper arrangement for proportioning air admitted to a zone or room.

When high pressure or high velocity air is employed in the system, a plurality of pressure reducing zone control distributing units are required. The zone control pressure reducing distributing units can be fed cold and warm conditioned air from one or a plurality of central conditioning apparatus.

It is possible to use the present invention in conjunction with low pressure air systems, but it finds particular utility when employed with high pressure air conditioning systems. As an example, the sizes of the ducts employed leading to the valve or damper controlling air supply to the distributing unit can have a maximum size of about 2" to 6" in diameter or its equivalent, the pressure being over about 2" of water static pressure and the potential velocity of air in the air ducts between about 1500 and 3500 feet per minute. It is to be understood that variations can be made in these limits and the

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system still be considered a high pressure system.

In a preferred aspect of the invention, dampers or valves can be arranged to control the cold and warm air pipes entering a zone control distributing unit. Operating means for the valves can be provided with adjustable mechanism permitting partial closing of one valve before the other is opened. Thus, there will not be an undesirable increase in the total volume of air at the moment of opening of the second valve. This can be accomplished by providing yieldable connections between the dampers and their operator. The dampers can be operated by a conventional air motor controlled by a condition responsive or thermostatically operated pressure relay arrangement, the thermostat being responsive to room or zone temperature.

These and other objects, advantages, and features of the invention will become apparent from the following description and drawings which are merely exemplary.

In the drawings:

Figure 1 is a fragmentary view partly in section showing a window box type of zone control distributing unit, the right or warm air valve being shown in fully opened position.

Figure 2 is a section taken along the line 2—2 of Figure 1.

Figure 3 is an enlarged view of a modified form of valve which can be used in conjunction with the damper arrangement on Figures 1 and 2.

Figure 4 is a fragmentary enlarged sectional view of the dampers shown in Figure 1, the control arm or interconnection being moved so that the left or cold air damper is about to open, the right hand or warm air valve having been partially closed. The dot-dash lines illustrate the damper arrangement when the right hand duct is fully open or in the position illustrated in Figure 1.

Figure 5 is generally similar to Figure 4 with the exception that the arrangement has been adjusted differently from that of Figure 4, so that the point for the left hand damper to be opened, upon call for cold air, will be before that illustrated in Figure 4.

Figure 6 is a plan view of another form of the zone control distributing system showing a unit which can be used as a ceiling unit.

Figure 7 is a side view of Figure 6, taken along the line 7—7 of Figure 6.

Figure 8 is an enlarged fragmentary sectional view of one of the valves showing in detail one manner of construction.

Figure 9 is a fragmentary sectional view of another form of valve arrangement.

First, a window box type of zone control distributing unit will be described such as one illustrated in Figures 1 and 2, wherein the unit is located under the window **20** of the building. The unit also serves as a pressure reducing distributing unit when used in conjunction with a high pressure system. The unit may have a suitable cover **21**, with a pressure reducing or distributing enclosure **22** therein. The casing **22** may have sound absorbing material **23** on the inside, if desired. Cold air supply duct **24** can be connected with the casing, said duct being connected with the cold air riser or conduit from the conditioning apparatus. The warm air duct **25** normally is not quite as large as the cold air duct, being for example, about 80% of the size of the cold air duct and can be suitably connected with the warm air riser from the conditioning apparatus.

Damper motor **26** may be of any suitable type, such as a diaphragm air controlled motor, or can be an electrically operated motor. In the form illustrated, pressure relay **27** has air or fluid fed thereto from line **28**, the relay being controlled by a thermostat **29** (Fig. 1) located in the passageway **30** (Fig. 2). Passageway **30** may have a suitable grill arrangement **31** or may be merely a slot. Passage of air is induced through the passage **30** by the flow of air from the box through the reducing nozzle or slot **32**.

Damper motor **26** may be mounted on motor support **33** (Fig. 1) carried by frame **34**. The motor is connected by a motor link connection rod **35** to the pivoted arm **36**, said arm being pivotally connected at **37** to the motor support **33**. Cold air damper or valve **38** is operable by the cold air plunger **39**, said plunger being pivotally mounted at **40** to one end of the pivoted arm **36**. Plunger **39** is screw-threadedly engaged at one end to a clevis **41** (Fig. 4), said clevis being pivotally connected at **40** to arm **36**.

The valve or damper itself may comprise an upper seal plate **42** (Figs. 4, 8) with a sponge rubber or similar material valve element **43** mounted between the upper seal plate **42** and the lower seal plate **44**. The upper seal plate **42** and the lower seal plate **44** can be held in assembled relationship by means of screws **45**. A suitable spring housing or guide **46** is integrally mounted or suitably fastened to the lower seal plate **44**. The lower end of the spring housing **46** has a guide rod **47** depending therefrom, said guide rod being slidable through seal plate assembly guide **48**, seal plate assembly guide plate **48** being mounted transversely relative to cold air duct **24**. A guide pin **49** cooperates with guide plate **50** mounted on the upper seal plate so as to guide the reciprocating movement of the damper or seal. A suitable collar **51** can be adjustably mounted on plunger **39** for the purpose which will be described hereafter. The spring **52**, located in the spring housing **46**, presses on the enlarged end **53** of the plunger urging the plunger upwardly.

The warm air duct damper **60** (Fig. 1) comprises elements generally similar to those described for cold air duct damper **38**, there being a clevis **61** (Fig. 4) pivotally fastened at **62** to pivoted arm **36**. Clevis **61** has plunger **63** screw-threadedly connected therewith, lock nut **64** being provided for locking the same in adjusted position. Upper seal plate **65** has a sponge rubber or similar material seal valve element **66** carried between it and the lower seal plate **67**. Spring housing **68** depends from the lower seal plate **67**, said housing having a guide rod **69** mounted thereon. Plunger **63** has an enlargement **69A** and spring **68A** similar to the cold air valve arrangement.

With the plunger and motor related as generally illustrated in Figure 1, the warm air valve is opened its full amount for the particular adjustment in response to a call for maximum heat, the warm air valve being shown in the same maximum opened position in dot-dash lines in Figure 4. With the warm air valve thus open, spring **52** will be compressed by the end or enlargement **53** of the plunger **39**. When the thermostat calls for less heat, the damper motor will be operated thereby rotating the pivot arm **36** clockwise in Figures 1 and 4, the warm air damper continuing to close until it reaches the full line position illustrated in Figure 4. At this time, the upper surface of enlarged end **53** of cold air plunger **39** will engage the bottom of the cold air damper and will be in readiness to open the cold air damper upon further movement of the damper motor. Further rotation of the pivoted arm **36** then will start opening of the cold air damper as the arm **36** continues to close the warm air damper It is apparent that at the time of opening of the cold air damper, the warm air damper will have been closed a predetermined amount, so that as the cold air damper opens, the combined volume of air coming out of the two ducts will not be more than that from the wide open warm air duct when in wide open position. It has been found that adequate control can be accomplished when the total volume is considerably below that admitted from one damper at the time of opening of the other valve. The settings are so arranged that the same operation takes place in the case of the cold air damper as the warm air duct is first opened following its having been moved to a closed position.

When it is desired to change the relationship between the dampers so that the warm air damper will be closed a less amount at the instant of opening of the cold air damper, the parts can be adjusted to positions illustrated in Figure 5. Collar **51** in this instance is moved downwardly on the plunger **39** relative to its previous position (Fig. 4) from a location **51A** (Fig. 5). In this case, the enlarged end **53** of the plunger rod **39** will not compress spring **52** as much as the spring is compressed in Figure 4. In other words, the overtravel of plunger **39** following closure of the valve **38** will be less than that of Figure 4. Also, as the plunger rod **39** moves upwardly, valve plate **43** will be contacted by the enlarged end **53** of the plunger rod and start to open prior to the time that it opens in Figure 4. The position of the warm air valve at the point of opening or closing of the cold air damper is shown in dot-dash lines at A in Figure 5. It is seen that this is greater than the opening in Figure 4 (full lines) when the cold air damper is at the point of being opened.

When the cold air damper and plunger is in the position illustrated in full lines in Figure 5, it is necessary to adjust the opening of the warm air damper **66** relative to the end of warm air duct **25** so that it is open the same amount as when fully open in Figure 4. This can be accomplished by shortening the warm air plunger **63** by means of its screw-threaded connection with clevis **61**.

With the adjustment illustrated in Figure 5, as the pivoted arm 36 is rotated clockwise by the damper motor, the enlarged end 53 will reach the bottom plate of damper 43 on its way upwardly and be in a position to start opening thereof at which point damper 66 will have moved to the dot-dash position "A" which is a wider opening than that shown in Figure 4 at the point of opening of the cold air damper.

Details of one form of valve and damper arrangement is shown in Figure 8, but it is to be understood that changes may be made therein.

In place of the flat valve, such as illustrated in Figure 1, a spherically shaped valve means 116 having a valve element 118 with a spherical-like surface (Figure 3), can be employed. Such a valve element may be mounted on seal plate 117, said plate having a bushing 119 with a spring housing corresponding with the spring housing arrangement of Figures 4 and 5. The valve element cooperates with duct 115 in a manner similar to Figures 4 and 5.

Another example of the invention is illustrated in Figure 9 wherein a zone control pressure reducing enclosure 83 may have warm air pipe 84 and cold air pipe 85 connected thereto. These are connected to valve boxes 86 and 87 having warm air aperture 88 and cold air aperture 89 opening into the pressure reducing distributing enclosure 83. Motor support 90 is mounted on valve boxes 86, 87 said support carrying a suitable diaphragm motor 91 similar to that described for the previous forms. Said motor can have an adjustable connection 92 pivotally connected at 93 with the pivoted arm 94. Pivoted arm 94 has a link 95 connecting one end of arm 94 with the warm air valve 96. The link 95 may include a valve spring retainer or guide 97 pivotally connected at 98 to the pivoted arm 94. Valve plunger 99 is adjustably screw-threadedly connected at 100 with the clevis 101 which in turn is pivotally connected at 102 to the warm air valve plate 96. Plunger 99 has an enlarged portion 103 serving as an abutment for spring 104 carried in guide 97. The guide 97 is shown diagrammatically and can be made of any suitable construction whereby the spring may be assembled with the various parts shown. Valve plate 96 is pivoted at 105 to the warm air valve box 86.

Cold air valve plate 106 is connected through plunger 107, spring 108, and guide 109 to the pivoted arm 94 at 110. Said plunger is screw-threadedly connected at 111 with a clevis 112 similar to that described for the warm air valve.

The link 92 and plungers 99 and 107 can be suitably adjusted so that each valve will be opened the desired amount when the other is closed and that it will open the desired amount when the other is closed and that it will close the desired amount as the other starts to open in the same way as that described for the previous forms. The valve springs will allow travel of the pivoted arm beyond the closing position of either valve. When this occurs, the link 92 and other parts may be adjusted so as to open the other valve the desired amount. The adjustable collars limiting movement of the rods are omitted, but suitable means can be used to limit travel of the arm 94 or the motor 91.

It is to be understood that variation may be made in the details of construction, including the use of other types of valve and control means without departing from the spirit of the invention except as defined in the appended claims.

What is claimed is:

1. In an air conditioning system distributing apparatus, the combination comprising a pair of dampers controlling mixing of air in said apparatus, a damper operating motor, arm means connecting said motor and said dampers, and yieldable plunger means between said arm means and said dampers, the plunger means being movable relative to its damper toward damper opening position when the damper is closed as the motor moves in a direction to open the damper, the other damper moving without movement of the first damper before said closed damper starts to open, thereby regulating and limiting the total volume of air admitted as the dampers are operated so that the combined volume of air from the two dampers is never more than that from the other when the other is wide open.

2. In a high pressure air conditioning system distributing unit, a pressure reducing box, a high pressure cold air conduit connected to said box, a high pressure warm air conduit connected to said box, dampers for said conduits controlling mixing of air in said box, condition responsive means, a pivoted arm connecting said condition responsive means with said dampers, and yieldable means between said dampers and said pivoted arm, the yieldable means being movable relative to a damper toward a damper opening position when the damper is closed as the condition responsive means moves in a direction to open the same, so that an open damper can move in a closing direction without movement of the other thereby limiting the total amount of air admitted so that the combined volume of air from the two dampers is never more than that from the other when the other is wide open.

3. In an air conditioning apparatus, the combination including an air distributing means, an ambient temperature thermostatically controlled damper motor, at least a pair of air supply conduits leading to said distributing means, damper operating connections between said motor and said dampers, and yieldable means in the connections between said motor and said dampers yieldably movable when its damper is closed as the other damper is closing before opening of the closed damper, the yieldable means being movable relative to its damper toward damper opening position when the damper is closed without movement of the closed damper, as the thermostatically controlled motor moves in a direction to open the damper, so that the combined volume of air from the two dampers is never more than that from the other when the other is wide open.

4. In an air conditioning system distributing apparatus having an air distributing means and a pair of conduits leading thereto, the combination including dampers for proportioning the flow of air through said conduits into said distributing means and into a zone, a condition responsive means, connections between said condition responsive means and said dampers, each of said connections including a yieldable element movable relative to a closed damper while the other open damper is being moved by the condition responsive means toward a closed position without movement of the closed damper, and adjustable means in the connections of each damper with said condition responsive means, so that the combined volume of air from the two dampers is never more than that from the other when the other is wide open.

5. In an air conditioning apparatus, the com-

bination including a pair of dampers controlling mixing of air in said apparatus, a pair of conduits controlled by said dampers, a damper operating motor, a pivoted arm connected to said motor, plungers connecting said arm to the dampers, an abutment on each plunger engageable with its damper, a spring normally urging each abutment into contact with its damper, said springs being yieldable as the damper is closed, a plunger being movable relative to its damper toward a damper opening position when the damper is closed without movement of the closed damper, as the motor moves to open the same, the other damper being moved toward closed position, so that the combined volume of air from the two dampers is never more than that from the other when the other is wide open.

6. In an air conditioning apparatus, the combination including a pair of dampers controlling mixing of air in said apparatus, a pair of conduits controlled by said dampers, a damper operating motor, a pivoted arm connected to said motor, plungers connecting said arm to the dampers, an abutment on each plunger engageable with its damper, a spring normally urging each abutment into contact with its damper, said springs being yieldable as the damper is closed, a spring for a damper being in yielded condition when the other damper is in full open position, so that as the damper motor is operated to open a closed damper, the open damper will close from its full open position, before the closed damper is engaged by the abutment on its plunger, and adjustable motion limiting means on each of said plungers engageable with a damper to limit motion of the plunger, so that the combined volume of air from the two dampers is never more than that from the other when the other is wide open.

7. In an air conditioning apparatus, the combination comprising an air distributing means, a pair of air supply conduits and dampers therefor controlling mixing of air in said apparatus, a condition responsive means connected through a plunger for each damper, a yieldable spring means for overtravel of a plunger after a damper has been closed, an adjustable abutment on each plunger limiting said overtravel, said overtravel governing the amount the other damper closes before a closed damper is opened as the condition responsive means operates said dampers, and means for adjusting the length of each plunger, so that the combined volume of air from the two dampers is never more than that from the other when the other is wide open.

8. In an air conditioning apparatus, the combination comprising an air distributing means, a pair of air supply conduits and dampers for said conduits controlling mixing of air in said distributing means, a condition responsive means, a pivoted arm connected to said condition responsive means, plungers connected to said arm on either side of its pivot, a yieldable spring means for overtravel of a plunger after a damper has been closed, an adjustable abutment on each plunger limiting said overtravel, said overtravel governing the amount the other damper closes before a closed damper is opened as the condition responsive means operates to open the closed damper, and means for adjusting the length of each plunger, so that the combined volume of air from the two dampers is never more than that from the other when the other is wide open.

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