

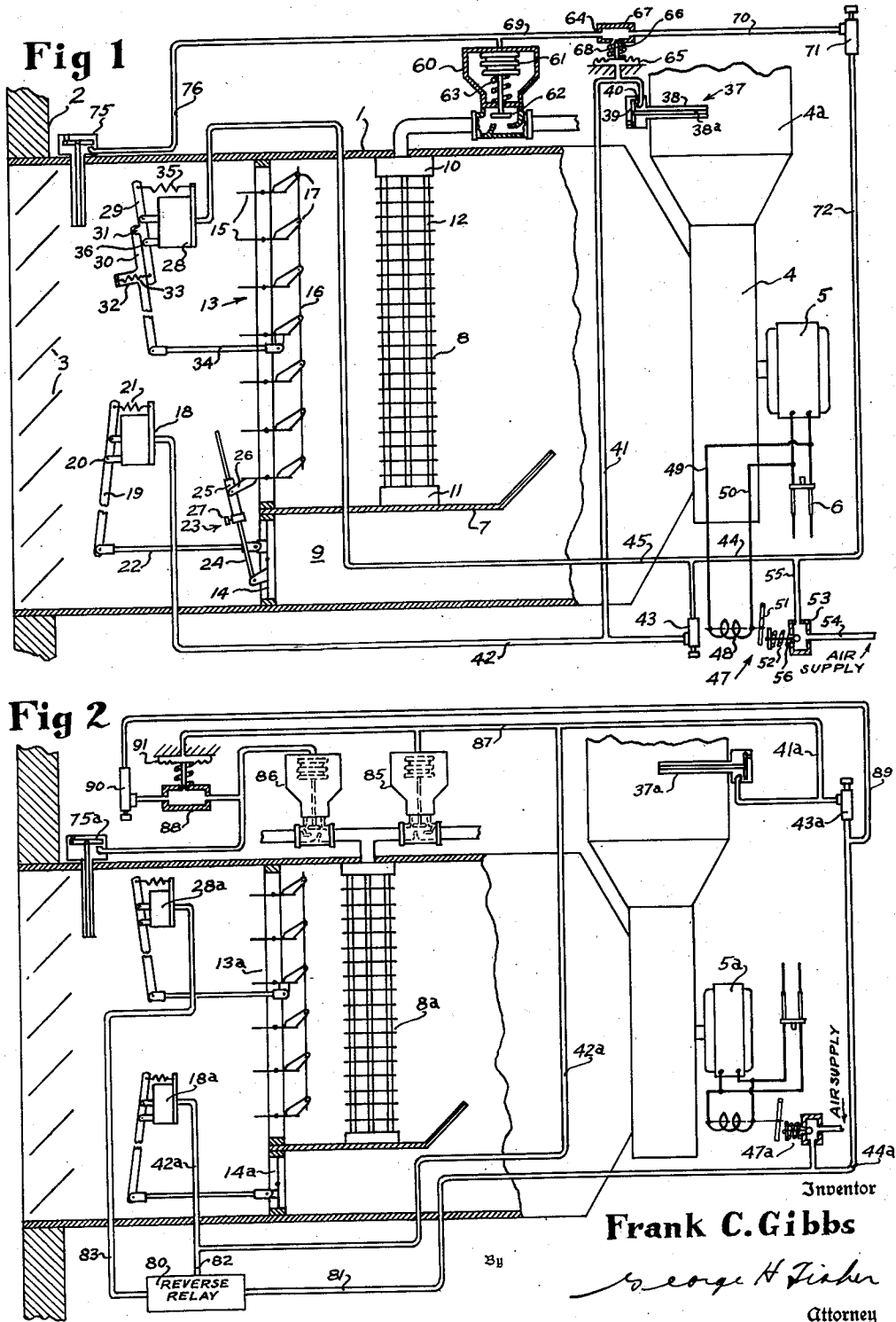
April 9, 1940.

F. C. GIBBS

2,196,494

CONTROL SYSTEM

Filed March 25, 1938



Inventor
Frank C. Gibbs

George H. Fisher
Attorney

UNITED STATES PATENT OFFICE

2,196,494

CONTROL SYSTEM

Frank C. Gibbs, Oak Park, Ill., assignor to
Minneapolis-Honeywell Regulator Company,
Minneapolis, Minn., a corporation of Delaware

Application March 25, 1938, Serial No. 198,084

20 Claims. (Cl. 236—38)

This invention relates to air conditioning and is more particularly concerned with the provision of a damper control mechanism for actuating a pair of dampers in unison during one period of time while actuating the dampers independently of each other at other times.

More specifically it is an object of this invention to provide a control arrangement for controlling the heating of fresh air being supplied to a space, this control arrangement utilizing face and by-pass dampers for controlling the temperature of the air supplied when the system is in operation, and acting to prevent admission of fresh air to the conditioning apparatus when the apparatus is out of operation.

It is a further object of this invention to provide a control system for fresh air heating means which utilizes a by-pass and damper means for controlling the heater, and in which the flow of heating medium is also controlled in a manner normally to place the heater out of operation when the by-pass is completely open, but which maintains the heater in operation irrespective of the damper position when outdoor temperatures approach the freezing point.

Other objects consists of various novel combinations and subcombinations of control apparatus and will become apparent from the following description and the appended claims.

For a full disclosure of my invention reference is made to the following detailed description and to the accompanying drawing in which:

Figure 1 diagrammatically illustrates one form which my invention may take; and

Figure 2 diagrammatically illustrates a modification.

Referring to Figure 1, reference character 1 indicates an air conditioning chamber or duct, the left end of which may extend through a wall 2 to communicate with the exterior of a building. This inlet of the duct or chamber 1 may be provided with a plurality of louvres 3. The right-hand end of the duct or chamber 1 may be connected to a fan 4, this fan in turn being connected to a discharge duct 4a for conveying the fresh air to the space or spaces being conditioned. The fan 4 may be driven by means of an electric motor 5, this motor being controlled by means of a switch 6. The interior of the chamber or duct 1 may be divided by means of a baffle 7 to form a passage for receiving a heating element 8 and a by-pass passage 9 for permitting air to be by-passed around the heater 8. The heater 8 may be of any desired type and is shown as being

formed of a pair of headers 10 and 11 connected together by a plurality of fin tubes 12.

The flow of air across the heater 8 and through the by-pass 9 is controlled by means of a set of face dampers 13 and a by-pass damper 14, respectively. The face damper 13 may consist of a plurality of damper blades 15 which are connected together for movement in unison by means of a cross connection 16 which may consist of a rod pivotally attached to a plurality of brackets 17 which are mounted upon the blades 15. The by-pass damper 14 is shown as consisting of a single damper blade. It will be understood however that if desired the by-pass damper may be formed similarly to the face damper 13. The damper 14 is actuated by means of a pneumatic motor 18, this motor being of usual form and comprising a lever arm 19 which is pivoted at 20 and which is actuated by means of a diaphragm motor in one direction and actuated by means of a spring 21 in the other direction. The lever arm 19 may be attached to the damper 14 by means of a link 22. It will be apparent that with the arrangement just described, when the damper motor 18 is deflated the spring 21 will cause movement of the lever arm 19 in a clockwise direction about its pivot 20, this causing the damper 14 to be moved to its closed position as shown. Upon inflation of the damper motor 18 however, the lever arm will be rotated in the opposite direction against the action of the spring 21 for opening the damper 14. The position assumed by the damper 14 will therefore vary with the pressure applied to the damper motor 18.

In order to actuate the face damper 13 in unison with the by-pass damper 14, a cross connection 23 is provided, this cross connection consisting in part of a rod 24 which is pivotally attached to the by-pass damper 14. This rod in turn is loosely fitted into a sleeve 25 which sleeve is pivoted to a bracket 26 which may be mounted upon the lowermost damper blade 15. The rod 24 is also provided with an adjustable stop member 27 which is adapted to abut the lower end of the sleeve 25 for thereby causing movement of the sleeve 25 with movement of the rod 24. It will be apparent that as the by-pass damper 14 is opened by the damper motor 18, the rod 24 will move upwardly, this causing the stop 27 to abut the sleeve 25 thereby moving the face damper in unison with the by-pass damper. It should be noted however that with this arrangement, the face damper may be rotated to closed position without accompanying movement of the by-pass

damper, this action being permitted by movement of the sleeve 25 on the rod 24.

The face damper 13 is provided with an additional damper motor 28. This motor may be of the same general type as the damper motor 18. However in this case the lever arm 29 is shortened and carries a second lever arm 30 which is pivoted to the arm 29 at 31. The lever arm 30 is provided with a lug or ear 32 to which is attached a spring 33, the other end of this spring being attached to the lever arm 29 as shown. The lever arm 30 actuates the face damper 13 through a link 34 which is attached to one of the damper blades 15. When the damper motor 28 is inflated, the lever arm 29 will be rotated in a counter-clockwise direction about its pivot 35. The lever arm 30 will simultaneously be rotated due to the action of the spring 33 which tends to hold the lever arm 30 in parallel relationship with the lever arm 29. Therefore when the damper motor 28 is inflated, the lever arm 30 will rotate in a counter-clockwise direction this causing the link 34 to move the damper blades 15 towards open position, this causing the sleeve 25 to be moved downwardly and held in abutting relationship with the stop 27 on the rod 24. At this time when the by-pass damper 14 is opened by the damper motor 18, the face damper 13 will be simultaneously moved towards closed position, the spring 33 allowing movement of the face damper at this time without requiring collapsing of the diaphragm in the motor 28. However, when the damper motor 28 is deflated, its spring 35 will cause movement of the lever arm 29 and the lever arm 30 in a clockwise direction, this causing the face damper 13 to be moved to closed position. This movement of the face damper to closed position will not be interfered with by the by-pass damper 14, for the reason that the sleeve 25 will merely slide upwardly on the rod 24. It should therefore be seen that the damper motor 28 when deflated acts to close the face damper 13, while when inflated moves the damper towards open position, this taking up the lost motion between sleeve 25 and stop 27 thereby causing the damper 13 to move in unison with the by-pass damper 14.

The by-pass damper motor 18 may be controlled in any suitable manner depending upon the particular application of the damper control mechanism. For instance if the damper is applied to a preheater in the fresh air duct of a large air conditioning system, the damper motor 18 may be controlled in accordance with the temperature of the air leaving the preheater, or may even be controlled in accordance with the temperature in the space being conditioned. For purpose of illustration the damper motor 18 is shown as being controlled by a discharge duct thermostat 37. The thermostat 37 is illustrated as being of the rod and tube type wherein an expansible tube 38 actuates a flapper valve 39 by means of a rod 38a which extends within the tube 38. As the temperature of the discharge air increases, the tube 38 will expand thus moving the flapper valve 39 towards the bleed port 40. This bleed port 40 may be connected by pipes 41 and 42 to the damper motor 18, the pipe 42 in turn being connected to a restriction 43 which leads from an air supply main 44. Assuming that air pressure of for instance, 15 pounds per square inch, is present in the main 44, this air will bleed through the restriction 43 into the pipes 41, 42, and the damper motor 18. When the temperature at the thermostat 37 is too low the

flapper valve 39 will allow air to bleed at a maximum rate from the bleed port 40, this causing the damper motor 18 to be deflated which closes the by-pass damper 14 and opens the face damper 13 as shown. At this time it will be noted the damper motor 28 will be inflated due to the fact that this damper motor is connected by a pipe 45 to the air supply main 44. The face damper 13 will therefore assume a position corresponding to the position of the by-pass damper 14. As the temperature at the thermostat 37 increases, the valve member 39 will approach the port 40 for restricting the bleeding of air, this causing pressure to build up within the damper motor 18 for moving the by-pass damper towards open position and simultaneously moving the face damper towards closed position. When the valve member 39 is moved sufficiently close to the port 40 as to cause a pressure of for instance 12 pounds per square inch to be applied to the damper motor 18 this motor will have caused the by-pass damper 14 to be moved to wide open position thereby completely closing the face damper.

In accordance with this invention, provision is made for closing both the face and by-pass dampers whenever the system is placed out of operation. For this purpose I prefer to utilize an electric-pneumatic switch 47 for controlling the air supply to the system in accordance with operation or non-operation of the fan motor 5. The electric pneumatic switch 47 may be of any suitable type and is diagrammatically illustrated as comprising a relay coil 48 which is connected across the fan motor terminals by means of wires 49 and 50. This relay coil 48 actuates an armature (not shown) which in turn actuates a pivoted lever 51, this lever actuating the valve stem 52 of a three-way valve 53. This three-way valve is connected to an air supply pipe 54, and to the air supply main 44 by pipe 55. The three-way valve 53 is also provided with a vent port 56. When the relay coil 48 is energized, the lever 51 will be actuated so as to permit the valve stem 52 to move its valve member for closing the vent port 56 thereby allowing air to be supplied to the main 44. However, when the fan switch 6 is opened, the relay coil will be deenergized thereby permitting the lever arm 51 to be moved by gravity or springs (not shown) for pushing the valve stem 52 to the right for closing off the air supply and opening the vent port 56.

From the foregoing description it should be apparent that when the fan motor 5 is in operation, air will be supplied to the main 44 thus placing the damper motor 18 under the control of the thermostat 37 and inflating the damper motor 28 for causing the face damper 13 to move in unison with the by-pass damper 14. When however the fan motor is deenergized, the electric-pneumatic switch will vent the main 44 thereby venting and deflating the damper motors 18 and 28. The deflating of the damper motor 18 will cause this motor to close the by-pass damper 14, and the deflating of the damper motor 28 will cause this motor to close the face damper 13. Thus whenever the fan is placed out of operation, both the face and by-pass dampers will be moved to closed position for preventing the entry of outside air into the chamber or duct 1.

In accordance with this invention provision is also made for controlling the supply of heating medium to the heat exchanger or heating coil 8. This arrangement will now be described. The flow of heating medium to the heating coil 8 may

be controlled by means of a direct acting valve 60. This valve may include a pressure actuated diaphragm 61 which is adapted to actuate a valve member 62. As the pressure within the diaphragm 61 is increased, this diaphragm will expand against the action of spring 63 for closing the valve. The valve 60 may be controlled by means of an accumulator 64 which comprises a diaphragm 65 connected to the thermostat pipe 41. This diaphragm actuates a valve stem 66 cooperating with a valve port for permitting air to bleed from a chamber 67, a spring 68 being provided for biasing the valve towards open position. The chamber 67 is connected to the diaphragm 61 of valve 60, by pipe 69 and is also connected by a pipe 70 to a restriction 71 which in turn is connected by a pipe 72 to the air supply main 44. The accumulator just described may be adjusted so as to cause the valve member to close the valve when the pressure applied to diaphragm 65 is raised to 12 pounds per square inch, while causing the port to be open when the pressure is below this value. If desired this accumulator 64 may be designed so as to snap from open to closed position to thereby provide two-position control. It will be apparent that when the temperature at thermostat 37 is low enough to cause this thermostat to reduce the air pressure in the damper motor 18 and the diaphragm 65 below 11 pounds, the by-pass damper 14 will be open to some extent and also the bleed port in the accumulator 64 will be wide open this causing the valve 60 to be wide open for supplying heating medium to the heat exchanger 8. As the temperature at thermostat 37 rises however, the pressure applied to the damper motor 18 and the diaphragm 65 of accumulator 64 will be increased. When this pressure increases to a value of for instance 11 pounds per square inch, the face damper will be completely closed and the by-pass damper will be wide open. Upon a slightly further increase in temperature at thermostat 37, the pressure will be raised to 12 pounds per square inch, this causing the accumulator 64 to close its bleed port thereby accumulating pressure in the diaphragm 61 of valve 60 for causing this valve to close.

In order to prevent any damage of the air conditioning or heating apparatus due to freezing, a thermostat 75 may be provided at the inlet of the chamber 1 so as to respond to outdoor temperature. This thermostat may be of the same type as the thermostat 37 and may be arranged to close its bleed port when outside temperature is above 35° F. while opening the bleed port when the outside temperature falls below this value. The thermostat 75, it will be noted, is connected by pipe 76 to the diaphragm 61 of the valve 60. Thus whenever the outdoor temperature is below 35° F., the bleed port of thermostat 75 will be open and this will vent the diaphragm 61 of valve 60 for causing the valve 60 to remain open regardless of the action of the accumulator 64. Therefore whenever the outdoor temperature approaches the freezing point, the valve 60 will be caused to remain open at all times and this will prevent any possibility of freezing of the heater 8 or other air conditioning apparatus. Due to the valve 60 being controlled by a branch line which is separate from the branch line for the damper motor 18, the action of the thermostat 75 in opening the valve 60 will in no way disturb the control of the face and by-pass dampers by the thermostat 37. It should also be noted that whenever the fan is placed out of operation, the diaphragm 61 of the valve 60 will be deflated for causing the

valve 60 to open simultaneously with the closing of the face and by-pass dampers. Therefore when the system is placed out of operation, heating medium will continue to be supplied to the heat exchanger 8 for preventing any possibility of freezing of the apparatus due to possible leakage of air and conduction of heat through the dampers.

While in the foregoing description, definite values of pressure and temperature have been mentioned, it will be understood that these values are merely illustrative and may be varied for different types of installations or applications of my invention.

Referring to Figure 2, this figure shows a modified arrangement for controlling the face and by-pass dampers. In this case the face damper 13a is not cross-connected with the by-pass damper 14a as in Figure 1, and the dampers are separately controlled by independent damper motors. The face damper 13a is actuated by means of a damper motor 28a, and the by-pass damper 14a is actuated by means of a damper motor 18a. As in the case of Figure 1, the air supply to the controls is controlled by means of an electric-pneumatic switch 47a connected across the terminals of the fan motor 5a. The air supply main 44a is connected through a restriction 43a to the thermostat 37a and this thermostat is connected by pipes 41a and 42a to the by-pass damper motor 18a. The control of the by-pass damper 14a is exactly the same as in Figure 1. In other words as the temperature at the thermostat 37a increases, its flapper valve is moved nearer to the bleed port, thereby building up pressure in the damper motor 18a for causing this damper motor to open the by-pass damper 14a. Upon a decrease in temperature at thermostat 37a, this thermostat will decrease the pressure applied to damper motor 18a for causing closing of the by-pass damper 14a.

The face damper motor 28a is controlled in unison with the by-pass damper motor 18a through a reverse relay 80. This reverse relay may be of any desired type and is shown as having an air supply pipe 81 connected to the air supply main 44a. This relay is also connected by pipe 82 to the pipe 42a which leads from the thermostat 37a to the damper motor 18a. The reverse relay is also connected by a pipe 83 with the damper motor 28a. The function of the reverse relay 80 is to cause the pressure in pipe 83 to vary inversely with variations in pressure in pipe 82. Thus when the thermostat 37a increases the pressure applied to damper motor 18a, the reverse relay 80 will cause the pressure in pipe 83 and consequently the pressure applied to the damper motor 28a to decrease a corresponding amount. Thus when the thermostat 37a increases the pressure applied to damper motor 18a for opening the by-pass damper 14a, the pressure applied to the face damper motor 28a will be decreased for causing the face damper 13a to be closed an amount corresponding to the opening movement of the by-pass damper 14a. In this manner the face and by-pass dampers are caused to be moved in unison but in opposite manners in accordance with variations in temperature at the thermostat 37a.

When the fan is placed out of operation the electric-pneumatic switch 47a will vent both the damper motor 18a and the damper motor 28a and this action will cause closing of the face damper 13a and also cause closing of the by-pass damper 14a. The arrangement illustrated in Figure 2 therefore functions to perform the same

result as the damper control arrangement of Figure 1.

In Figure 2 I have also shown a modified form of control arrangement for controlling the supply of heating medium to the heating coil 8a. In this case the flow of heating medium to the heater 8a is controlled by a pair of valves 85 and 86. The valve 85 is directly connected to the thermostat 37a by pipe 87 which is connected to pipe 41a. The valve 85 will therefore be modulated in position with variations in temperature at the thermostat 37a. The valve 86 however is controlled through an accumulator or relay 88 which may be of the snap acting or graduating acting type. This relay or accumulator it will be noted is connected to the air supply main 44a by means of pipe 89 and a restriction 90. The diaphragm 91 of this accumulator or relay is connected to the thermostat 37a as shown. Thus as the temperature at thermostat 37a increases, the rate of bleeding is diminished which causes the pressure applied to the diaphragm 91 to be increased, this causing the valve stem to be moved downwardly for diminishing the rate of bleed through the bleed port of device 88, this causing the pressure applied to the diaphragm of valve 86 to be increased. Thus as the temperature at the thermostat 37a increases, this thermostat will increase the pressure applied to the valves 85 and 86 for causing these valves to be closed, as well as moving the dampers in a manner to cause closing of the face damper 13a and opening of the by-pass damper 14a. The various springs of the valve motors and the relay may be so chosen as to provide any desired sequence of operation of the valves 85 and 86. The valve 86 may also be connected to a thermostat 75a for preventing this valve from closing in the event that outdoor temperature approaches the freezing point, thereby supplying a sufficient quantity of heating medium to heater 8a to maintain it in operation for preventing damage to the apparatus.

From the foregoing description it should be apparent that I have provided a face and by-pass damper control arrangement in which the face and by-pass dampers move in unison but in opposite manners under the action of a controller when so desired, and in which the face and by-pass dampers can also be moved independently of each other to predetermined positions. It should further be apparent that I have provided a face and by-pass damper control system in which the heater is also automatically controlled conjointly with the face and by-pass dampers and in which the heater is automatically maintained in operation without disturbing the control of the face and by-pass dampers whenever the outdoor temperature approaches the freezing point. While a preferred application of my novel damper control arrangement is for providing a combined face and by-pass damper and fresh air damper my invention is not limited to this specific application and may be applied to other dampers which actuate in unison. Also while I have shown a damper control system in which both dampers are simultaneously moved to closed position, it will be apparent that in some instances the dampers could be reversed so as to simultaneously assume wide open position instead of completely closed position. As many other modifications of my invention will occur to those skilled in the art I desire to be limited only by the scope of the appended claims.

I claim as my invention:

1. In a system of the class described, in

combination, a condition changer, means for causing air to flow into contact with said condition changer, face damper means for controlling the flow of air into contact with said condition changer, a by-pass for air around said condition changer, by-pass damper means for controlling the flow of air through said by-pass, a first damper motor for said face damper means, a second damper motor for said by-pass damper means, control means for controlling said damper motors for causing movement of said damper means in unison but in opposite manners to thereby vary the proportions of the air passed through said condition changer and said by-pass, a controller arranged for placing said control means into and out of control relationship with said damper motor means, and means for causing movement of said damper motor means for actuating said face damper means and said by-pass damper means in the same manner to predetermined positions when said controller is actuated for placing said controlling means out of control relationship with said damper motor means.

2. In a system of the class described, in combination, a condition changer, a fan for causing air to flow into contact with said condition changer, a by-pass, for air to flow around said condition changer, face damper means for controlling the flow of air into contact with said condition changer, by-pass damper means for controlling the flow of air through said by-pass, a controller for said condition changer, motor means for actuating said condition changer controller, a face damper motor means for actuating said face damper means, a by-pass damper motor means for actuating said by-pass damper means, control means for actuating said condition changer controller motor means, and for actuating at least one of said damper motor means for causing movement of said damper means in unison but in opposite manners to thereby vary the proportions of the air passed through said condition changer and said by-pass, a fan controller for placing said fan into and out of operation, means actuated by said fan controller for placing said control means in control relationship with said condition changer controller motor means and said damper motor means as above described when the fan is in operation, and for placing said control means out of control relationship with said damper motor means when the fan is out of operation, and means for causing movement of both of said damper motor means for actuating said face damper means and said by-pass damper means in the same manner to predetermined positions, when said fan is placed out of operation.

3. In a system of the class described, in combination, duct means for conveying outside air to a space to be conditioned, a heater for heating said fresh air, means for supplying heating medium to said heater, flow control means for controlling the supply of heating medium, thermostatic means for controlling said flow control means in a manner to maintain a predetermined temperature at said thermostatic means, and thermostatic means influenced by outside temperature for preventing said first thermostatic means from reducing the supply of heating medium below a predetermined value when outside temperature approaches a value likely to cause freezing to thereby prevent damage due to freezing, said outside thermostatic means having no effect on the control by said first thermostatic

means when outside temperature is above a value liable to cause freezing.

4. In a system of the class described, in combination, duct means for conveying outside air to a space to be conditioned, a heater for heating the fresh air, means for supplying heating medium to said heater, flow control means for controlling the supply of heating medium to said heater, a by-pass around said heater, damper means for controlling the relative proportions of the air passed through said heater and said by-pass, thermostatic means for controlling said flow control means and said damper means in a manner to maintain a predetermined temperature at said thermostatic means, and means influenced by outside temperature for preventing said thermostatic means from reducing the supply of heating medium to said heater below a predetermined value without influencing the control of said damper means by said thermostatic means, when outdoor temperature falls below a predetermined value.

5. In a system of the class described, in combination, duct means for conveying outside air to a space to be conditioned, a heater for heating the fresh air, means for supplying heating medium to said heater, flow control means for controlling the supply of heating medium to said heater, a by-pass around said heater, damper means for controlling the relative proportions of the air passed through said heater and said by-pass, thermostatic means for controlling said flow control means and said damper means in a manner to maintain a predetermined temperature at said thermostatic means, and means influenced by outside temperature for additionally controlling said flow control means without disturbing the control of said damper means by said thermostatic means, said outside temperature influenced means being arranged to prevent said thermostatic means from reducing the flow of heating medium beyond a predetermined extent when the outdoor temperature falls to a predetermined low value.

6. In a system of the class described, in combination, duct means for conveying outside air to a space to be conditioned, a heater for heating the fresh air, means for supplying heating medium to said heater, flow control means for controlling the supply of heating medium to said heater, a by-pass around said heater, damper means for controlling the relative proportions of the air passed through said heater and said by-pass, motor means for actuating said damper means, thermostatic means, connections between said damper motor means and said thermostatic means for causing said damper means to assume positions in accordance with the temperature at said thermostatic means, a relay controlled by said thermostatic means, said relay being arranged to control said flow control means, and means influenced by outside temperature for preventing said relay from reducing the supply of heating medium to said heater beyond a predetermined extent when outside temperature falls to a predetermined low value.

7. In a system of the class described, in combination, a first damper means, a second damper means, a first motor means for controlling said first damper means, a second motor means for controlling said second damper means, control means for controlling both of said damper motor means for causing movement of said damper means in unison but in opposite manners, a controller for placing said control means into and out

of control relationship with said damper motor means, and means for causing movement of said damper motor means for actuating both of said damper means in the same manner to predetermined positions when said controller is actuated for placing said control means out of control relationship with said damper motor means.

8. In a system of the class described, in combination, a first damper means, a second damper means, a first damper motor for actuating one of said damper means, a lost motion cross-connection between said damper means, said cross connection being arranged to move said other damper means in unison with but in an opposite manner to said motor actuated damper means when the lost motion is taken up, while permitting movement of the other damper means in one direction independently of said motor actuated damper means, and a second damper motor for selectively operating said other damper means in a manner to take up said lost motion, or to move said other damper means to a predetermined position independently of said motor actuated damper means.

9. In a system of the class described, in combination, a first damper means, a second damper means, a first damper motor for actuating one of said damper means, a lost motion cross-connection between said damper means, said cross connection being arranged to move said other damper means in unison with but in an opposite manner to said motor actuated damper means when the lost motion is taken up, while permitting movement of the other damper means in one direction independently of said motor actuated damper means, a second damper motor for selectively operating said other damper means in a manner to take up said lost motion, or to move said other damper means to a predetermined position independently of said motor actuated damper means, and a yieldable connection between said second damper motor and said other damper means for permitting movement of said damper means in unison without actuation of said second motor means.

10. In a system of the class described, in combination, a first damper means, a second damper means, a first damper motor for actuating one of said damper means, a lost motion cross-connection between said damper means, said cross connection being arranged to move said other damper means in unison with but in an opposite manner to said motor actuated damper means when the lost motion is taken up, while permitting movement of the other damper means in one direction independently of said motor actuated damper means, a second damper motor for selectively operating said other damper means in a manner to take up said lost motion, or to move said other damper means to a predetermined position independently of said motor actuated damper means, and a common controller for both of said damper means, said controller being arranged when in one position to operate said second damper motor in a manner to take up said lost motion, and when in its other position to operate said second damper in the opposite direction to move its damper to said predetermined position, while operating said first damper motor to move its damper to a predetermined position.

11. In a system of the class described, in combination, a first damper means, a second damper means, a first damper motor for actuating one of said damper means, a lost motion cross-con-

nection between said damper means, said cross-connection being arranged to move said other damper means in unison with but in an opposite manner to said motor actuated damper means when the lost motion is taken up, while permitting movement of the other damper means in one direction independently of said motor actuated damper means, a second damper motor for selectively operating said other damper means in a manner to take up said lost motion, or to move said other damper means to a predetermined position independently of said motor actuated damper means, a yieldable connection between said second damper motor and said other damper means for permitting movement of said damper means in unison without actuation of said second motor means, and a common controller for both of said damper means, said controller being arranged when in one position to operate said second damper motor in a manner to take up said lost motion, and when in its other position to operate said second damper in the opposite direction to move its damper to said predetermined position, while operating said first damper motor to move its damper to a predetermined position.

12. In a system of the class described, in combination, a first flow control means, a motor therefor, a second flow control means, a motor for actuating said second flow control means, each of said motors being of the type which assume predetermined positions when deenergized, said motors being associated with their corresponding flow control means in a manner to cause movement of said flow control means in the same manner when deenergized, means including means for controlling at least one of said motors for causing movement of said flow control means in unison but in opposite manners, and a controller for deenergizing both of said motors for causing movement of both of said flow control means in the same manner to predetermined positions.

13. In a system of the class described, in combination, a first flow control means, a second flow control means, a first motor for actuating said first flow control means, a second motor for actuating said second flow control means, each of said motors being of the type which assumes predetermined positions when deenergized, a condition responsive device for controlling said motors, reversing means interposed between said condition responsive device and one of said motors for causing said motors to be controlled in unison and in reverse manner by said condition responsive device, and a controller for deenergizing both of said motors for causing movement of both of said flow control means in the same manner to predetermined positions.

14. In a system of the class described, in combination, a first flow control means, a second flow control means, a first motor means for controlling said first flow control means, a second motor means for controlling said second flow control means, means including control means for controlling at least one of said motor means for causing movement of said flow control means in unison but in opposite manners, a controller for placing said control means into and out of control relationship with said motor means, and means for causing movement of both of said motor means for actuating said flow control means in the same manner to predetermined positions when said controller is actuated for placing said control means out of control relationship with said motor means.

15. In a system of the class described, in combination, a first flow control means, a second flow control means, a first pressure actuated motor for controlling said first flow control means, a second pressure actuated motor for controlling said second flow control means, said motors being arranged to cause movement of their respective flow control means in the same manner upon change in applied pressure in the same direction, means including control means for controlling at least one of said motors for causing movement of said first and second flow control means in unison but in opposite manners, and means for changing the pressures applied to said motors in the same direction irrespective of said control means for causing said flow control means to assume predetermined positions.

16. In a system of the class described, in combination, a first flow control means, a second flow control means, a first pressure actuated motor for controlling said first flow control means, a second pressure actuated motor for controlling said second flow control means, each of said motors being arranged to cause closing of its associated flow control means upon relieving of pressure applied thereto, means including control means for controlling at least one of said motors for causing movement of said first and second flow control means in unison but in opposite manners, and means for relieving pressure applied to both of said motors irrespective of said control means for causing closure of both of said flow control means.

17. In a system of the class described, in combination, a condition changer, means for causing air to flow into contact with said condition changer, face damper means for controlling the flow of air into contact with said condition changer, a by-pass for the air around said condition changer, by-pass damper means for controlling the flow of air through said by-pass, a first pressure actuated damper motor for said face damper means, said first damper motor being arranged to cause said face damper means to open as pressure is applied to said first motor while causing said face damper means to close as pressure is relieved from said first motor, a second pressure actuated motor for actuating said by-pass damper means in a manner to open said by-pass damper means upon increase in pressure applied to said second motor and to close said by-pass damper means upon decrease in pressure, means including control means for controlling pressure applied to said motors for causing movement of said dampers in unison but in opposite manners to thereby vary the proportions of air passed through said condition changer and said by-pass, and means for relieving pressure from both of said motors irrespective of said control means for causing closure of both said face damper means and said by-pass damper means.

18. In a system of the class described, in combination, a first damper means, a second damper means, a first pressure actuated damper motor for actuating said first damper means, said first damper motor being arranged to cause movement of said damper means in a first direction upon decrease in pressure applied thereto while causing movement of said damper means in the opposite direction upon increase in pressure applied thereto, a lost motion cross connection between said first and second damper means for causing movement of said damper means in unison

when the lost motion is taken up, a second pressure actuated motor for actuating said second damper means, said second motor adapted upon change in pressure applied thereto from one value to another to move said damper from a predetermined position to a position in which said lost motion is taken up, a first controller for graduately controlling the pressure applied to said first motor and a second controller for changing the pressure applied to both motors for causing said dampers to assume predetermined positions.

19. In a system of the class described, in combination, a first flow control means, a second flow control means, a first pressure actuated motor for actuating said first flow control means, a second pressure actuated motor for actuating said second flow control means, said pressure actuated motors assuming predetermined positions when the pressure applied thereto is relieved, a condition responsive device for controlling the pressure applied to said motors for causing movement of said motors in unison, reversing relay means interposed between said condition, responsive device and one of said motors to thereby cause said motors to be controlled reversely by said condition responsive device, and a controller for relieving pressure from both of said motors irrespective of said condition responsive means for causing movement of both

of said motors in the same manner to predetermined positions.

20. In a system of the class described, in combination, duct means for conveying outside air to a space to be conditioned, a heater for heating the fresh air, means for supplying heating medium to said heater, valve means having a pressure actuated motor for controlling the supply of heating medium to said heater, a source of fluid under pressure, first thermostatic means influenced by the heater for controlling the flow of pressure fluid from said source to said motor for controlling the pressure applied to said motor in a manner to maintain a predetermined temperature at said thermostatic means, control valve means associated with said pressure actuated motor for causing opening of said heating medium valve independently of said first thermostatic means, and thermostatic means influenced by outside temperature for positioning said control valve means in a manner to cause opening of said heating medium valve means when outside temperature approaches a value likely to cause freezing of the heater while positioning said control valve means for placing said first thermostatic means in full control of said heating medium valve when outside temperature is above a predetermined value.

FRANK C. GIBBS.