

SPECIFICATION

**Air Conditioning System Including a System
Powered Damper Blade Assembly**

This invention relates to an air conditioning
5 system including a damper blade assembly
rotatably mounted within a duct provided to
deliver conditioned air to an enclosure and
wherein the position of the damper blade
assembly within the duct is controllable in
10 accordance with the sensed supply air pressure
and temperature of the air in the enclosure.

Many multiroom structures, such as office
buildings and schools, constructed during the past
several years, include air conditioning systems to
15 deliver either relatively warm or cool conditioned
air from a central source thereof to each of the
enclosures or rooms in the building. Typically, one
or more ducts are employed to deliver the air to
each enclosure. Very often, a damper blade
20 assembly or similar mechanism is installed in the
duct to regulate the flow of air to one or more
diffusers or discharge outlets located in the
enclosure being conditioned by the discharge of
air thereinto. The movement of the damper blade
25 assembly may be responsive to changes in the
conditioned air supply pressure and/or changes in
the temperature of the enclosure.

In some air conditioning systems of the prior
art, the diffusers or discharge outlets located in
30 the enclosure being conditioned have included an
inflatable bellows to regulate the flow of
conditioned air into the enclosure. Inflation of the
bellows has been controlled through a device
responsive to the pressure of the supply air to
35 maintain a substantially constant volume flow of
conditioned air into the enclosure. In addition, in
some of the systems, a temperature responsive
device has been combined with the pressure
responsive device to reduce the flow of
40 conditioned air as the temperature in the
enclosure approaches a desired predetermined
level. The pressure responsive device delivers a
pressure signal to the bellows which is
proportional to but less than supply air pressure.
45 As the temperature of the air in the enclosure
approaches a predetermined set point, the
temperature responsive device will function to
increase the magnitude of the signal to the
bellows to increase the inflation thereof. When it
50 is desired to eliminate all flow of conditioned air,
the pressure signal to the bellows will essentially
approach the supply air pressure.

In other air conditioning systems, it has been
found desirable to regulate the flow of air through
55 the duct by providing a damper blade assembly
within the duct upstream of the discharge outlets
or diffusers. A bellows is inflated in direct
response to changes in the supply air pressure to
maintain a substantially constant volume flow of
60 conditioned air. Typically, the bellows pressure is
approximately identical to the supply air pressure.
Thus, if it is desired to decrease the air flow as the
temperature in an enclosure approaches a
predetermined level or set point, an additional

65 force must be generated to move the damper
blade assembly.

None of the known prior arrangements used to
modulate the flow of condition air through a duct
by varying the position of a damper blade
70 assembly within the duct have been as efficient as
the arrangement of the present invention. The
instant invention has been found to be extremely
effective in regulating the flow of air through a
duct to a plurality of discharge outlets whereby
75 the flow of air is maintained substantially
constant irrespective of any changes in the
conditioned air supply pressure. The present
invention includes temperature responsive means
to reduce the flow of air below the predetermined
80 level as the temperature in an enclosure
approaches a predetermined set point.

According to the present invention there is
provided an air conditioning system including a
conditioned air supply duct for delivering
85 conditioned air to an enclosure comprising:

a damper assembly for modulating the flow of
conditioned air including a housing positioned in
the air flow path through said duct and a damper
blade pivotally mounted within said housing;

90 at least one cutoff plate mounted in said
housing with said damper blade and cutoff plate
defining therebetween a flow path for said
conditioned air;

a first plate pivotally mounted within said
95 housing about the same axis of rotation as said
damper blade and being spaced therefrom for
defining a first space;

a second plate mounted within said housing in
a predetermined fixed position spaced from said
100 first plate for defining a second space, said first
plate being located between said damper blade
and said second plate;

a first inflatable bellows disposed within one of
said spaces, the degree of inflation of said bellows
105 varying directly with the pressure of said
conditioned air in said housing upstream of said
damper assembly, said damper blade moving
relative to said second plate in response to
inflation of said bellows to maintain a
110 substantially constant volume flow of air to said
enclosure irrespective of changes in said
conditioned air supply pressure; and

temperature override means including second
inflatable bellows disposed within the other of
115 said spaces to move said damper blade relative to
said second plate, the degree of inflation of said
second bellows varying inversely with the
difference between sensed air temperature of said
enclosure and a predetermined set point
120 temperature, with the damper blade being moved
thereby to reduce the flow of air below said
substantially constant level as the temperature of
the air in said enclosure approaches said
predetermined set point.

125 The single figure of the drawing illustrates a
sectional, somewhat schematic, view of a
conditioned air supply duct having a damper
blade assembly mounted therein in accordance
with the present invention.

Referring now to the drawing, there is disclosed a preferred embodiment of the present invention, including a control for regulating the position of a damper blade assembly of the type used to control the flow of air through a duct employed to deliver conditioned air from a central source thereof to at least one outlet or diffuser located in a room.

Duct 11 is employed to deliver conditioned air from a central source thereof (not shown) to an enclosure or room in a multiroom building such as an office or school. The conditioned air flows through the duct to one or more discharge outlets or diffusers located in various enclosures in the building.

A rotatable damper assembly 12 is positioned within a casing or housing 10 connected between inlet duct 11 and outlet duct 19. The damper assembly is rotatably mounted on a shaft 21 extending transverse to the direction of air flow through duct 11. Shaft 21 is located at the approximate vertical centre of the opening 18.

Damper blade assembly 12 includes a damper 13 comprising an L-shaped member 15 having a relatively long leg 17 and a relatively short leg 20. The curved face of plate 20 confronts the flow of air through a flow opening 18 defined between a pair of spaced cutoff plates or seal members 14, 16. Cutoff plates 14, 16 are mounted within the duct to define therebetween the flow opening 18 for the conditioned air flowing from the upstream duct 11 to the downstream duct 19. The damper blade assembly is designed to regulate the flow of air through the flow opening. Damper 13 may be rotated in response to the pressure of the air upstream thereof and in response to the temperature of the air in the enclosure as shall be more fully explained hereinafter.

Damper blade assembly 12 further includes a pair of inflatable bladders 22 and 24. Bladder 22 is sandwiched between the opposed surfaces of plates 17 and 26. Plate 26 rotates about shaft center 21. Second inflatable bladder 24 is attached to the other surface of plate 26 and the opposed surface of a fourth plate 28. Plate 28 is fixed in a permanent position within casing 10. Inflation of either of the inflatable bellows 22, 24 will cause damper blade 13 to rotate in a counterclockwise direction as indicated by arrow 23.

A tube or conduit or similar device 30 has an open end 27 disposed in the air flow path upstream of air flow opening 18. Tube 30 has a pair of branches emanating therefrom, with a first branch 32 connected to first inflatable bellows 22 and the second branch 34 connected to second inflatable bellows 24. Thus, each of the bellows is inflated by the delivery of conditioned air thereto through the connecting tubes 30, 32, or 34.

A restrictor or similar flow control device 36 is placed within the flow path defined by tube 34. A bleed type thermostat 40 of the type well known to those skilled in the art is connected via line 42 to line 34 upstream of inflatable bellows 24.

Essentially, thermostat 40 is provided to sense

the temperature of the air in one of the enclosures served by the air conditioning system. Thermostat 40 will regulate the magnitude of the pressure signal furnished to bellows 24 by selectively communicating conduits 34, 42 with the atmosphere.

Typically, there are several outlets or diffusers attached to casing 10, with the air conditioning system including several additional supply air ducts, with each duct having its own diffuser(s). Accordingly, the conditioned air supply pressure upstream of the damper blade assembly will vary depending upon the actual number of discharge outlets that are in use at any one time. Thus, if it is desired to maintain a constant flow of conditioned air to the various outlets irrespective of changes in the conditioned air supply pressure, the damper blade assembly must be modulated or positioned so as to regulate the flow of air through flow opening 18 in accordance with the actual changes in the supply air pressure.

As noted previously, conduit 30 communicates the air duct at a point upstream of cutoff plates 14, 16 with first inflatable bellows 22. Thus, conditioned air at supply pressure is delivered to the first inflatable bellows. The degree of inflation of bellows 22 will vary directly with changes in the supply pressure. As the supply air pressure increases, inflation of bellows 22 will likewise increase to rotate damper 13 toward cutoff plate 14. Conversely, if the supply air pressure should decrease, the pressure in bellows 22 will correspondingly decrease with the damper thus rotating toward cutoff plate 16 through a system of springs and levers (not shown). Thus, a relatively constant flow of conditioned air is maintained through flow opening 18 irrespective of changes in the supply air pressure.

To permit a greater degree of control whereby the flow of air can be reduced below the predetermined constant volume level, conduit 34 communicates conduit 30 with second inflatable bellows 24. As noted previously, bleed type thermostat 40 is located upstream of inflatable bellows 24 in communication with conduit 34. Thermostat 40 is responsive to the temperature of the air in an enclosure served by duct 19. As the temperature of the air in the enclosure approaches a predetermined level or set point, the bleed type thermostat will prevent flow of air through conduit 42 to increase the degree of inflation of second bellows 24. This, in turn, will cause damper 13 to rotate upwardly toward cutoff plate 14 to reduce the flow of conditioned air through flow opening 18. Conversely, as the temperature of the air in the enclosure rises above the predetermined set point, the bleed type thermostat will open, thereby bleeding air from conduit 34 through conduit 42, to reduce inflation of bellows 24. Damper 13 will rotate in a clockwise direction to increase the flow through opening 18. However, in no case will the flow of air increase above the predetermined maximum constant volume level. Restrictor 36 is provided in conduit 34 to permit the inflation and deflation of

second bellows 24 in response to thermostat 40.

The predetermined constant volume flow of air is set by positioning the damper blade assembly within the fluid flow opening at an initial location.

- 5 Thus, for a given flow, as for example 1000 cfm, and for a given pressure, as for example 1" w.g., the damper blade assembly will have a specific location within opening 18. The predetermined location for the damper blade assembly is
- 10 regulated by rotating plate 26. Thus, if a larger quantity of constant volume air is desired, plate 26 of the damper blade assembly will be moved in a clockwise direction. A greater quantity of conditioned air will thence flow through the fluid
- 15 flow opening 18 to the downstream end of the duct. If it is desired to obtain a relatively smaller constant volume flow of air, plate 26 of the damper blade assembly is rotated in a
- 20 counterclockwise direction. The position of the damper blade assembly within the fluid flow opening 18 as determined by the angular position of plate 26 relative to the cutoff plates will determine the constant volume flow of air at a predetermined pressure. Any variations in the
- 25 actual supply air pressure will result in damper 13 rotating in the manner heretofore described to maintain the constant volume flow. Further, as the temperature in the enclosure approaches a predetermined set point, the damper blade will be
- 30 rotated in a counterclockwise direction due to inflation of bellows 24 to thereby reduce the flow of air below the constant volume level.

- The damper blade assembly is highly effective and efficient in regulating the flow of air to a plurality of discharge outlets or diffusers in
- 35 response to changes in supply air pressure and changes in the temperature of the enclosure.

Claims

1. An air conditioning system including a
- 40 conditioned air supply duct for delivering conditioned air to an enclosure comprising:
- a damper assembly for modulating the flow of conditioned air including a housing positioned in the air flow path through said duct and a damper
- 45 blade pivotally mounted within said housing;
- at least one cutoff plate mounted in said

housing with said damper blade and cutoff plate defining therebetween a flow path for said conditioned air;

- 50 a first plate pivotally mounted within said housing about the same axis of rotation as said damper blade and being spaced therefrom for defining a first space;
- a second plate mounted within said housing in
- 55 a predetermined fixed position spaced from said first plate for defining a second space, said first plate being located between said damper blade and said second plate;
- a first inflatable bellows disposed within one of
- 60 said spaces, the degree of inflation of said bellows varying directly with the pressure of said conditioned air in said housing upstream of said damper assembly, said damper blade moving relative to said second plate in response to
- 65 inflation of said bellows to maintain a substantially constant volume flow of air to said enclosure irrespective of changes in said conditioned air supply pressure; and
- temperature override means including second
- 70 inflatable bellows disposed within the other of said spaces to move said damper blade relative to said second plate, the degree of inflation of said second bellows varying inversely with the difference between sensed air temperature of said
- 75 enclosure and a predetermined set point temperature, with the damper blade being moved thereby to reduce the flow of air below said substantially constant level as the temperature of the air in said enclosure approaches said
- 80 predetermined set point.
2. An air conditioning system in accordance with claim 1, wherein said first inflatable bellows is disposed within said first space and said second inflatable bellows is disposed within said second
- 85 space, the angular position of said first plate and said first bellows within said housing for a predetermined conditioned air supply pressure determining the magnitude of said constant volume of conditioned air flow.
- 90 3. An air conditioning system substantially as herein described with reference to the accompanying drawing.



20

second bellows 24 in response to thermostat 40.

The predetermined constant volume flow of air is set by positioning the damper blade assembly within the fluid flow opening at an initial location.

- 5 Thus, for a given flow, as for example 1000 cfm, and for a given pressure, as for example 1" w.g., the damper blade assembly will have a specific location within opening 18. The predetermined location for the damper blade assembly is
- 10 regulated by rotating plate 26. Thus, if a larger quantity of constant volume air is desired, plate 26 of the damper blade assembly will be moved in a clockwise direction. A greater quantity of conditioned air will thence flow through the fluid
- 15 flow opening 18 to the downstream end of the duct. If it is desired to obtain a relatively smaller constant volume flow of air, plate 26 of the damper blade assembly is rotated in a counterclockwise direction. The position of the
- 20 damper blade assembly within the fluid flow opening 18 as determined by the angular position of plate 26 relative to the cutoff plates will determine the constant volume flow of air at a predetermined pressure. Any variations in the
- 25 actual supply air pressure will result in damper 13 rotating in the manner heretofore described to maintain the constant volume flow. Further, as the temperature in the enclosure approaches a predetermined set point, the damper blade will be
- 30 rotated in a counterclockwise direction due to inflation of bellows 24 to thereby reduce the flow of air below the constant volume level.

The damper blade assembly is highly effective and efficient in regulating the flow of air to a plurality of discharge outlets or diffusers in response to changes in supply air pressure and changes in the temperature of the enclosure.

Claims

- 40 1. An air conditioning system including a conditioned air supply duct for delivering conditioned air to an enclosure comprising:
- a damper assembly for modulating the flow of conditioned air including a housing positioned in the air flow path through said duct and a damper
- 45 blade pivotally mounted within said housing; at least one cutoff plate mounted in said

housing with said damper blade and cutoff plate defining therebetween a flow path for said conditioned air;

- 50 a first plate pivotally mounted within said housing about the same axis of rotation as said damper blade and being spaced therefrom for defining a first space;
- 55 a second plate mounted within said housing in a predetermined fixed position spaced from said first plate for defining a second space, said first plate being located between said damper blade and said second plate;
- 60 a first inflatable bellows disposed within one of said spaces, the degree of inflation of said bellows varying directly with the pressure of said conditioned air in said housing upstream of said damper assembly, said damper blade moving relative to said second plate in response to
- 65 inflation of said bellows to maintain a substantially constant volume flow of air to said enclosure irrespective of changes in said conditioned air supply pressure; and temperature override means including second
- 70 inflatable bellows disposed within the other of said spaces to move said damper blade relative to said second plate, the degree of inflation of said second bellows varying inversely with the difference between sensed air temperature of said enclosure and a predetermined set point
- 75 temperature, with the damper blade being moved thereby to reduce the flow of air below said substantially constant level as the temperature of the air in said enclosure approaches said predetermined set point.
- 80 2. An air conditioning system in accordance with claim 1, wherein said first inflatable bellows is disposed within said first space and said second inflatable bellows is disposed within said second
- 85 space, the angular position of said first plate and said first bellows within said housing for a predetermined conditioned air supply pressure determining the magnitude of said constant volume of conditioned air flow.
- 90 3. An air conditioning system substantially as herein described with reference to the accompanying drawing.