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Desmond et al.

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(54) **ECONOMIZER**

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(22) Filed: **Feb. 4, 2000**

(51) **Int. Cl.**[7] **F24F 13/04**
(52) **U.S. Cl.** **454/268**; 454/236
(58) **Field of Search** 454/268, 261, 454/269, 264, 324, 234, 236; 137/901, 864

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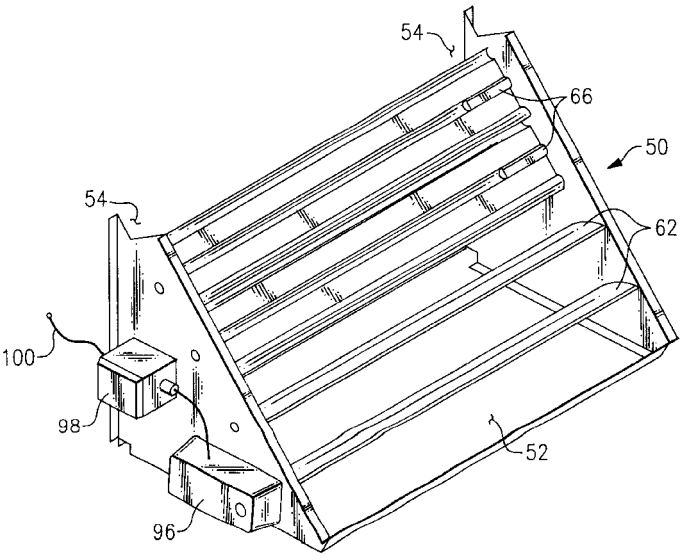
(57) **ABSTRACT**

The present invention is an economizer that is capable of mixing outside air and inside air while incurring a significantly low pressure drop across the return air damper. In one embodiment, the economizer comprises a mixing chamber, a return air vent, and an outside air vent. The economizer further comprises a plurality of curved return air dampers moveable from an open position to a closed position to control the flow of return air to the mixing chamber. The economizer further comprises a plurality of straight dampers moveable from an open position to a closed position to control the flow of outside air to the mixing chamber. During operation of the economizer, a significantly lower pressure drop exists across the curved return air dampers than in conventional economizers thereby reducing the amount of energy needed to operate fans to maintain the desired air flow.

4 Claims, 4 Drawing Sheets



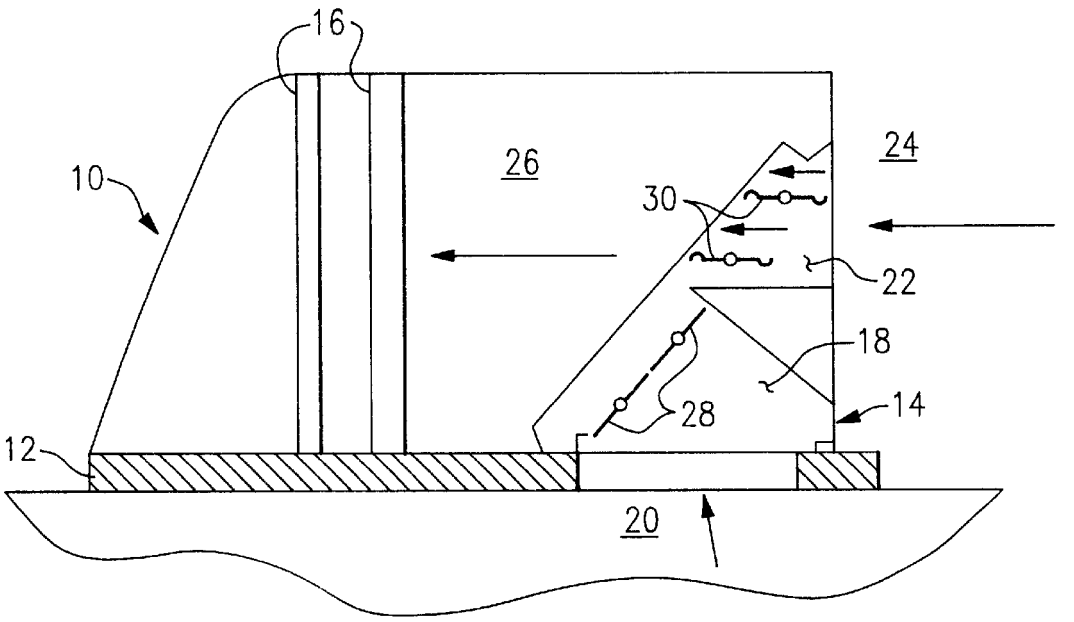


FIG.1
Prior Art

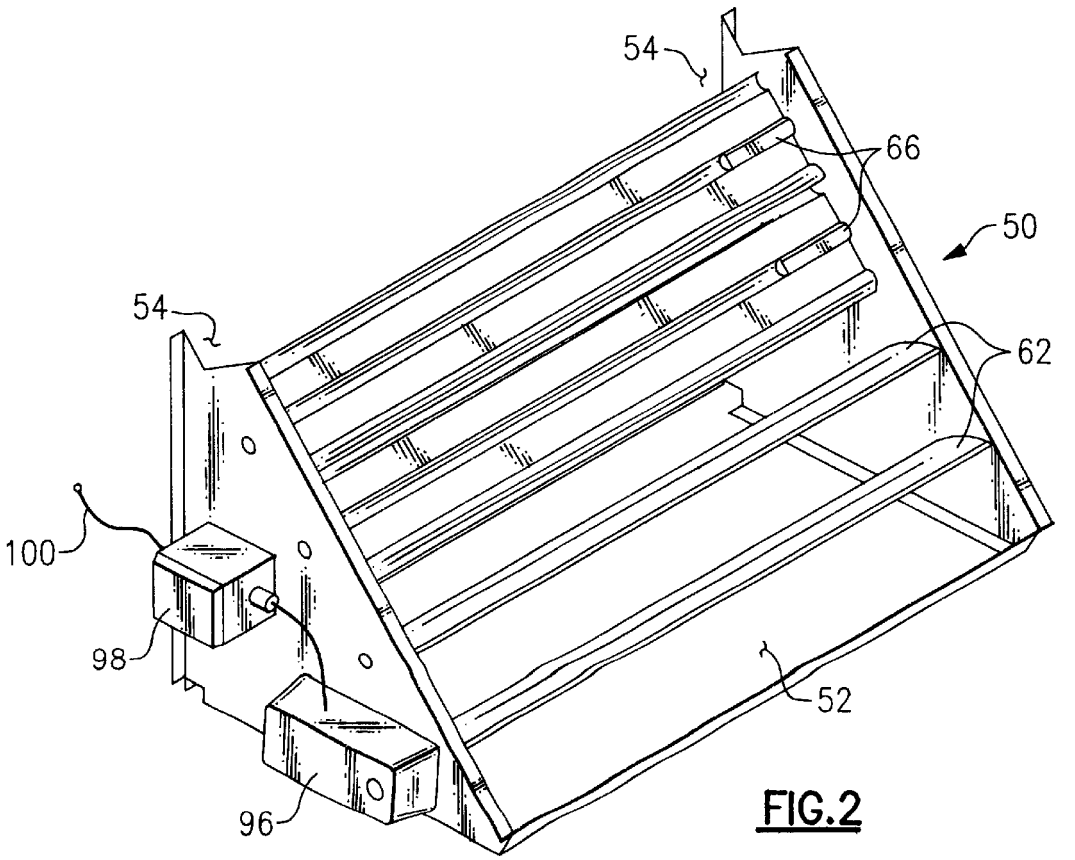


FIG.2

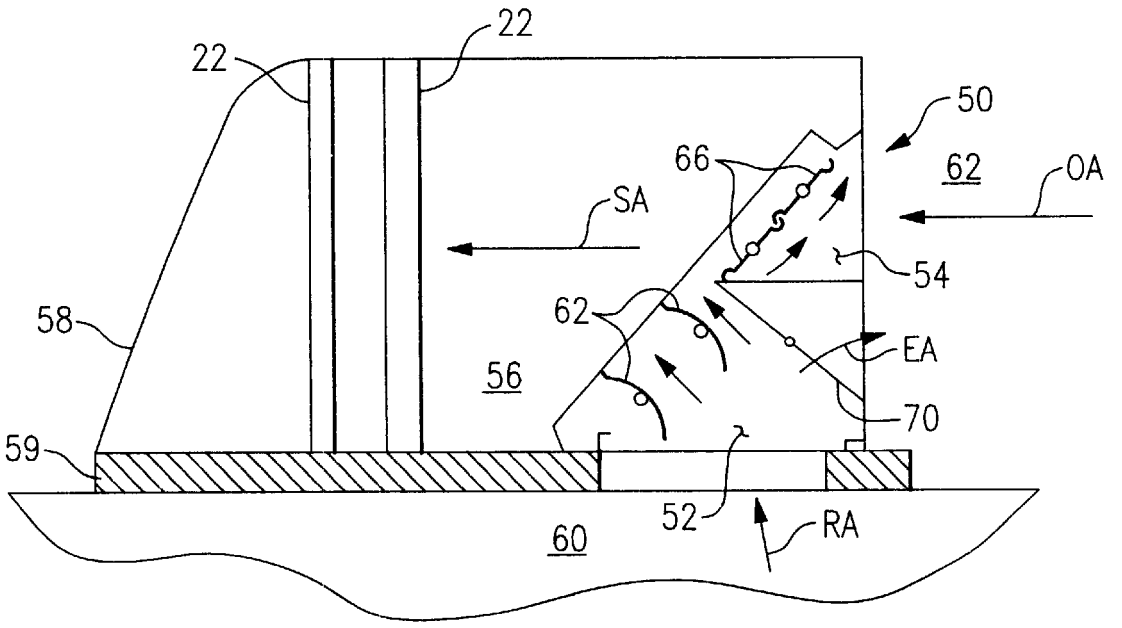

22
22
50
66
62
OA
SA
54
58
62
EA
56
70
59
52
RA
60

FIG.3

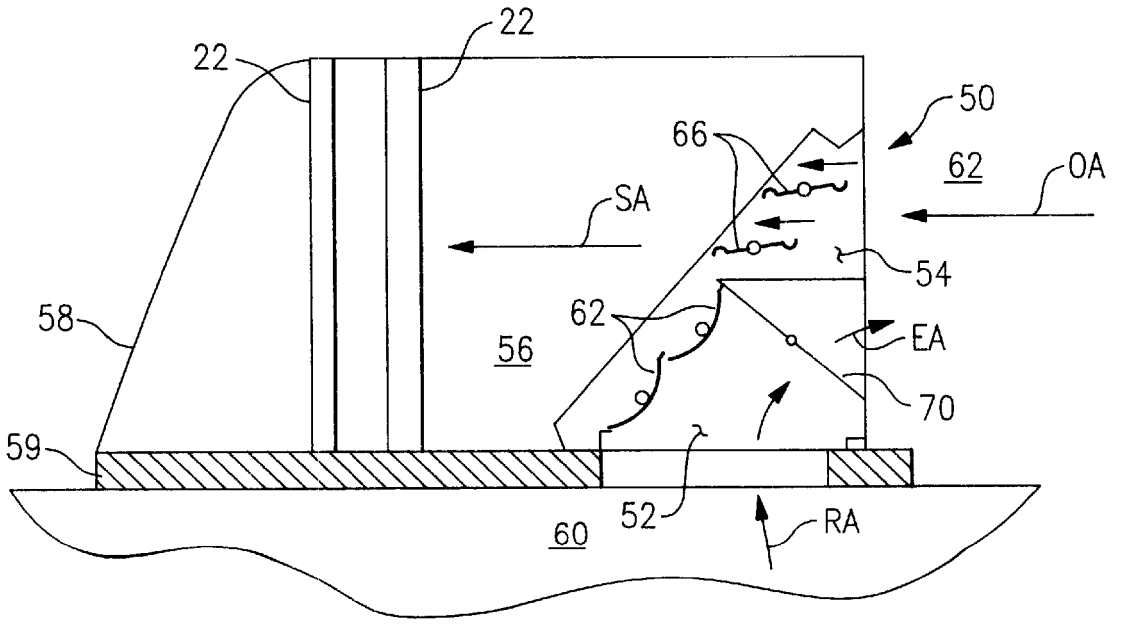

22
22
50
66
62
OA
SA
54
58
62
EA
56
70
59
52
RA
60

FIG.4

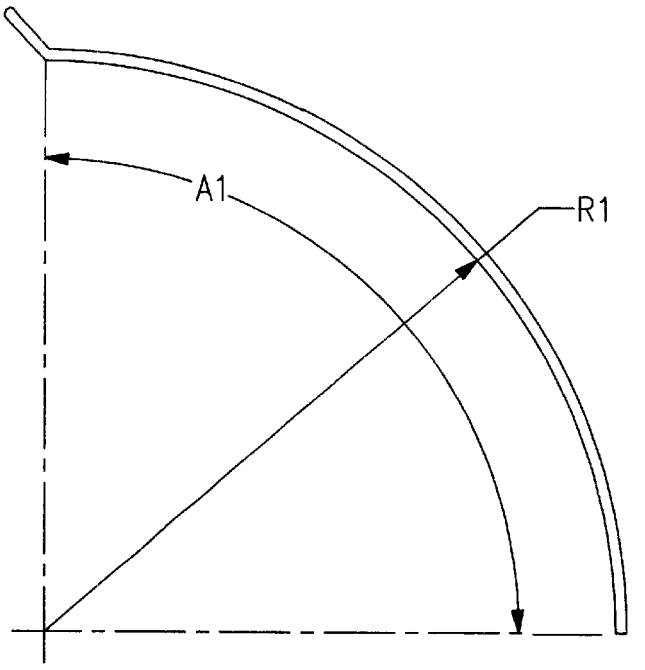

A1
R1

FIG.5

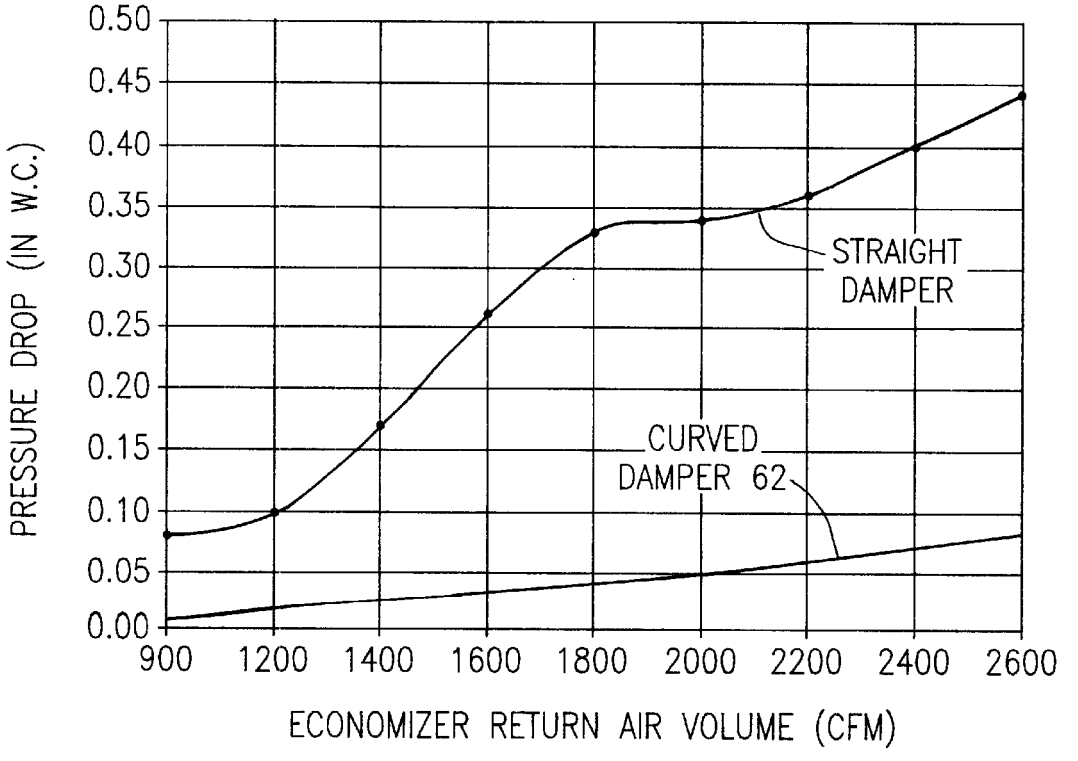

PRESSURE DROP (IN W.C.)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
900
1200
1400
1600
1800
2000
2200
2400
2600
ECONOMIZER RETURN AIR VOLUME (CFM)
STRAIGHT DAMPER
CURVED DAMPER 62

FIG.6

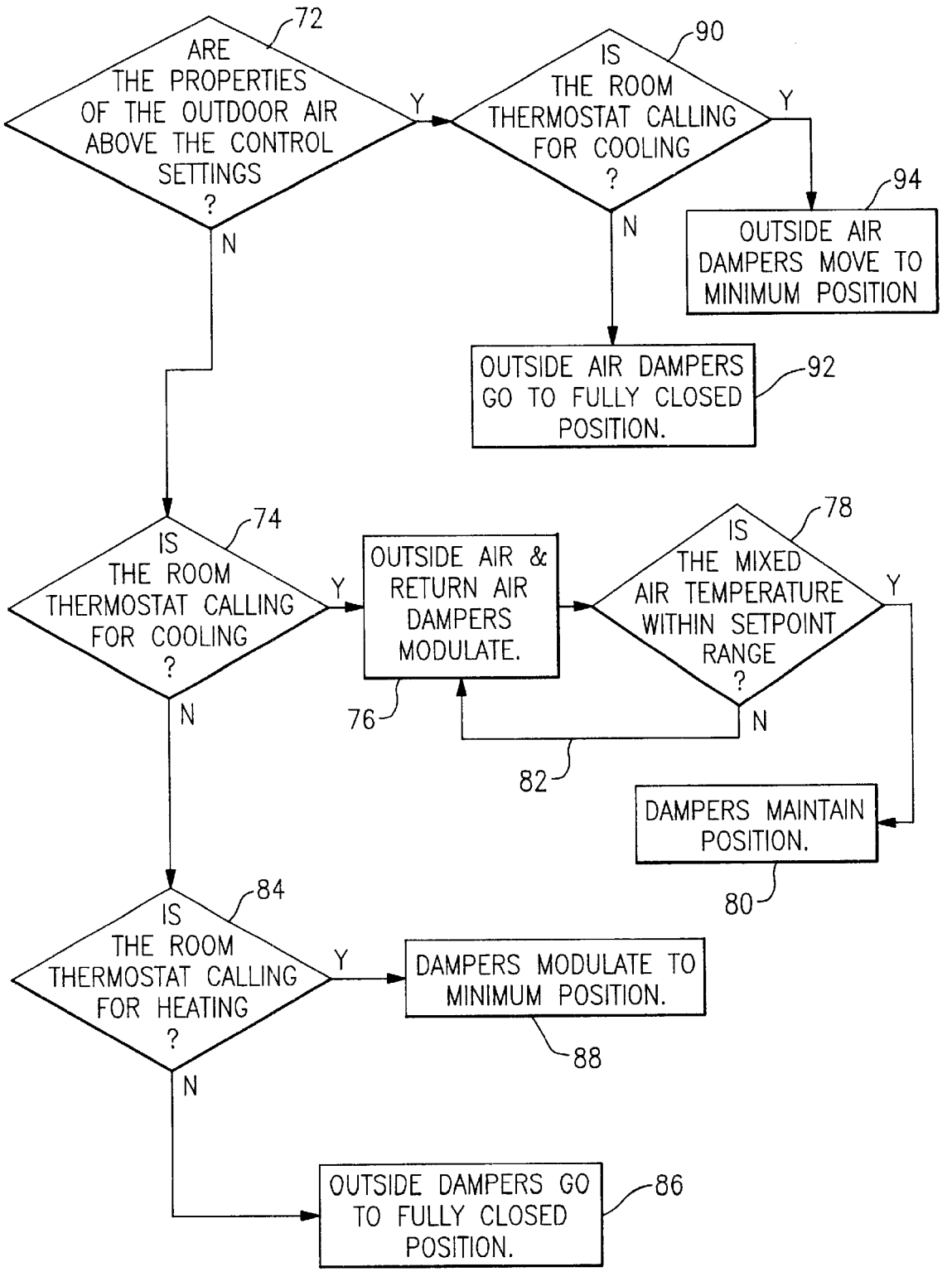

72
ARE THE PROPERTIES OF THE OUTDOOR AIR ABOVE THE CONTROL SETTINGS ?
Y
N
90
IS THE ROOM THERMOSTAT CALLING FOR COOLING ?
Y
N
94
OUTSIDE AIR DAMPERS MOVE TO MINIMUM POSITION
OUTSIDE AIR DAMPERS GO TO FULLY CLOSED POSITION.
92
74
IS THE ROOM THERMOSTAT CALLING FOR COOLING ?
Y
N
OUTSIDE AIR & RETURN AIR DAMPERS MODULATE.
76
78
IS THE MIXED AIR TEMPERATURE WITHIN SETPOINT RANGE ?
Y
N
82
DAMPERS MAINTAIN POSITION.
80
84
IS THE ROOM THERMOSTAT CALLING FOR HEATING ?
Y
N
DAMPERS MODULATE TO MINIMUM POSITION.
88
OUTSIDE DAMPERS GO TO FULLY CLOSED POSITION.
86

FIG.7

ECONOMIZER

FIELD OF THE INVENTION

The present invention relates generally to air handling systems. More particularly, the present invention relates to an economizer.

BACKGROUND OF THE INVENTION

Air handling systems are widely used to condition and distribute air within an internal space such as a commercial building. FIG. **1** shows a cross-section view of a conventional air handling system **10** mounted on a roof **12** having as a component an economizer **14** positioned upstream of air handling unit components **22**. By way of example, the air handling unit components **22** may include components such as a cooling coil, a heating coil, and/or a fan, all of which are costly to operate.

Generally, the economizer **14** consists of a return air vent **18** in communication with an internal space **20**, an outside air vent **22** in communication with the outside environment **24**, and a mixing chamber **26**. The return air vent **18** is in communication with the mixing chamber **26** by two straight dampers **28** which open and close thru a maximum angular rotation of **45** degrees to control the flow of return air into the mixing chamber **26**. Similarly, the outside air vent **22** is in communication with the mixing chamber **26** by two straight dampers **30** which open and close to control the flow of outside air to the mixing chamber **26**. Depending upon one or more the characteristics of the outside air (i.e, temperature, humidity, etc.) and desired characteristics of the supply air, the straight dampers **28** and **30** are synchronously moved by a control mechanism moved (not shown) to provide an optimum mixture of return air and outside air in the mixing chamber **20** which minimizes the operation of the air handling unit components **22** and the energy costs incurred therewith.

Conventional economizers of the type exemplified by FIG. **1** have several drawbacks. Movement and final position of the straight dampers **28** cause an excessive pressure drop across the straight damper **28**, thereby increasing the amount of energy needed to operate the second stage conditioning system **16** and/or the air handling system **10**.

OBJECTS OF THE INVENTION

One object of the present invention is to provide an economizer that has a significantly lower pressure drop across the return air vent when mixing return air and outside air.

SUMMARY OF THE PRESENT INVENTION

The present invention is an economizer that can mix outside air and return air while incurring a significantly low pressure drop across the return air damper than conventional devices. In one embodiment, the economizer comprises a mixing chamber, a return air vent, and an outside air vent. The economizer further comprises a plurality of curved return air dampers moveable from an open position to a closed position to control the flow of return air to the mixing chamber. The economizer further comprises a plurality of straight dampers moveable from an open position to a closed position to control the flow of outside air to the mixing chamber. During operation of the economizer, a significantly lower pressure drop exists across the curved return air dampers than in conventional economizers. When used in connection with commercial buildings, for example, the economizer of the present invention significantly reduces energy consumption associated with the operation of the overall air handing system which results in significant cost savings to the commercial customer.

BRIEF DESCRIPTION OF THE DRAWINGS

The following detailed description of the invention will be better understood with reference to the accompany drawings in which:

FIG. **1** is a cross section view of a conventional economizer;

FIG. **2** is a perspective view of the present invention;

FIG. **3** is a cross-section of the present invention showing the position of the curved dampers of the return air vent and the straight dampers of the outside air vent when the air handling system is not operating;

FIG. **4** is a cross-section of the present invention showing the position of the curved return air dampers and the straight outside air dampers when the air handling system is operating and the curved dampers and straight dampers are modulated to a given position within its range of modulation.

FIG. **5** is a cross-section view of the curved damper;

FIG. **6** is a graph showing that the curved dampers of the present invention incur significantly lower pressure drops than conventional straight dampers at a wide range of air flow rates; and

FIG. **7** is a high level flow chart showing the operation of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. **2–4**, wherein one embodiment of the economizer **50** of the present invention is generally shown comprising a return air vent **52**, an outside air vent **54**, a mixing chamber **56**. The economizer **50** is shown disposed within a conventional air handling system **58** mounted upon, for example, a roof **59** and a having for example, one or more air handling components **22** placed upstream of the economizer **50**.

The return air vent **52** is in communication with an internal space **60** and the mixing chamber **56**. The flow of return air (RA) from the internal space **60** into the mixing chamber **56** is controlled by the modulation and positioning of curved dampers **62**.

The outside air vent **54** is in communication with the outside environment **64** and the mixing chamber **56**. The flow of outside air (OA) from the outside environment **64** into the mixing chamber **56** is controlled by the modulation and positioning of straight dampers **66**.

The economizer **50** further comprises an exhaust vent **70** in communication with the internal space **60** and the outside environment **62**. The exhaust vent **70** may take a variety of designs such as a gravity hinged vent.

During Idle and Operational Mode, a significantly low pressure drop occurs across the curved dampers **62**. FIG. **6** shows a graph comparing pressure drop across the curved air dampers **62** verus the pressure drop across conventional straight air dampers: The data of FIG. **6** is summarized below:

Air Flow (cfm)	Pressure Drop (w.c.) Straight Dampers	Pressure Drop (w.c.) Curved Dampers
900	0.08	0.010
1200	0.10	0.017
1400	0.17	0.024
1600	0.26	0.031
1800	0.33	0.039
2000	0.34	0.048
2200	0.36	0.059
2400	0.40	0.070
2600	0.44	0.082

The data in FIG. **6** and the above table are based upon the curved return air dampers **66** having a radius R1 of 3.0 inches and being fully open. FIG. **5** shows a cross section vie of the curved return air damper **62** having a radius R1 and an arc length A1. The shape of the curved return air dampers **62** of the present invention allow the economizer **50** to mix return air without side air while incurring a significantly low pressure drop across the curved return air dampers **62**. When used in connection with commercial buildings, the economizer **50** of the present invention would significantly reduce energy consumption associated with the operation of the air handing system **58** which results in significant cost saving to the customer.

The economizer **50** further comprises a motor unit **96** engaged with and adapted to modulate the curved return air dampers **62** and the straight outside air dampers **66** as instructed by a control unit **98**. An air handling system control unit (not shown) is connected to the control unit **98** along a line **100**.

Referring to FIG. **7**, wherein a high level flow chart shows the general operation of the economizer **50** of the present invention within the Off Mode, Idle Mode and Operational Mode. As indicated by decisional block **72**, the control unit **98** operates to sense whether the properties of the outside air are above or below the control settings. If the properties of the outside air are below the control setting, control is passed to decisional block **74**.

As indicated by decisional block **74**, the control unit **98** operates to sense whether the thermostat is calling for cooling. If the thermostat is calling for cooling, control is passed to operational block **76**.

As indicated by operational block **76**, the control unit **98** operates to modulate the straight outside air dampers **66** and the curved return air dampers **62** toward a set point range. Control is then passed to a decisional block **78**.

As indicated by decisional block **78**, the control unit **98** operates to sense whether the air in the mixing air chamber **56** is within the set point range. If the air in the mixing chamber **56** is within the set point range control passed to decisional block **80** where the curved return air dampers **62** and the straight outside sir dampers **66** remain in position. If the air in the mixing chamber **56** is not within the set point range control is returned to operational block **76** where the straight outside air dampers **66** and the curved return air dampers **62** are modulated toward a set point range (the "Operational Mode"). The Operational Mode may include flow rates from twenty percent (20%) to eighty percent (80%) of return air and/or outside air.

Returning to decisional block **74**, if the thermostat is not calling for cooling, control is passed to a decisional block **84**. As indicated by decisional block **84** the control unit **98** operates to sense whether the thermostat is calling for heating. If the thermostat is not calling for heating, control is passed to operational block **86** where the straight outside dampers **66** are completely closed and the curved dampers **62** are completely open (the "Off Mode). If the thermostat is calling for heating, control is passed to operational block **88** where the straight outside air dampers **66** and the curved return air dampers **62** are modulated in the Operational Mode as heretofore described.

Returning to decisional block **72**, if the properties of the outside air are higher than the control settings, control is passed to decisional block **90**. As indicated by decisional block **90**, the control unit **98** operates to sense whether the thermostat is calling for heating. If the thermostat is not calling for cooling, control is passed to operational block **92** where the straight outside dampers **66** are completely closed and the curved return air dampers **62** are completely open. If the thermostat is not calling for cooling, control is passed to operational block **94** where the straight outside air dampers **66** are moved to a minimum position.

The foregoing description is intended primarily for purposes of illustration. This invention may be embodied in other forms or carried out in other ways without departing from the spirit or scope of the invention. Modifications and variations still falling within the spirit or the scope of the invention will be readily apparent to those of skill in the art.

What is claimed is:

1. An economizer for use within a packaged air conditioning unit having a limited overall available static pressure to deliver a controlled ratio of outside air to return air at different operating conditions, the economizer comprising:

(a) an air chamber;

(b) a return air duct in communication with said air chamber;

(c) a plurality of curved return air dampers disposed within said return air duct and moveable from an open position to a closed position to control the flow of the return air to said air chamber;

(d) an outside air duct in communication with said air chamber;

(e) a plurality of dampers moveable from an open position to a closed position to control the flow of the outside air to said air chamber; and

(f) a control unit adapted to control movement of said curved return air dampers and said outside air damper to deliver a controlled ratio of the outside air to the return air at different operating conditions, during operation of the economizer a significantly low pressure drop occurs across said curved return air dampers.

2. The system of claim **1**, wherein said curved dampers have a radius of about 3.0 inches.

3. The system of claim **1**, wherein said curved dampers have a radius between 1.0 and 2.0 inches.

4. The system of claim **1**, wherein said curved dampers can be rotated ninety degrees.

* * * * *