

[54] SMOKE-FUME EXHAUST SYSTEM

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98/39, 115 K; 200/61.03

[56] References Cited

UNITED STATES PATENTS

2,299,815 10/1942 Gent 200/61.03
3,323,439 6/1967 Weaver et al. 98/115 K

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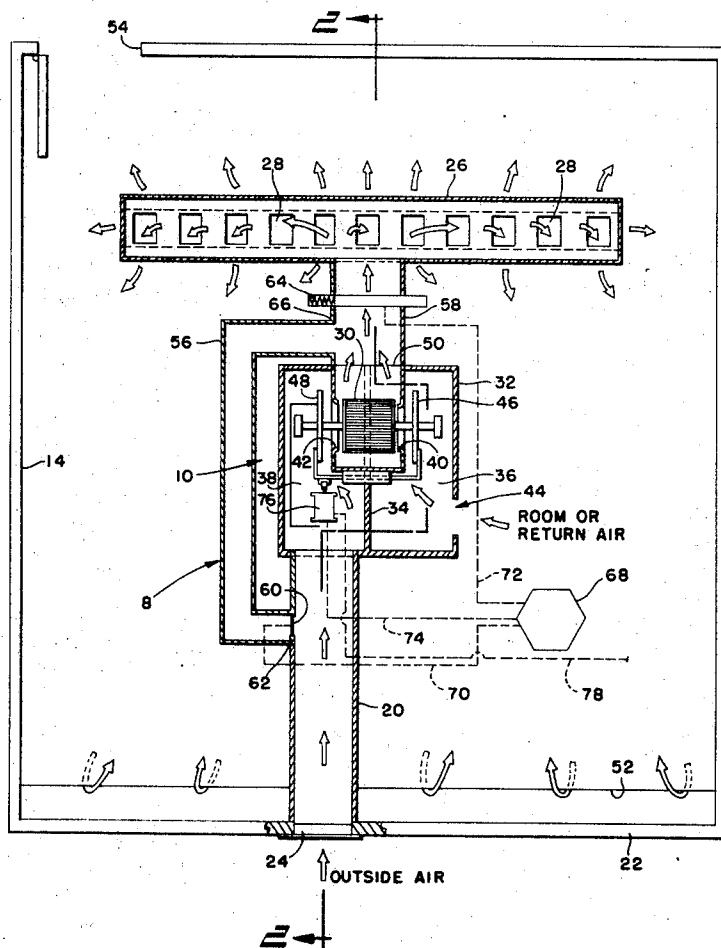
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ABSTRACT

A smoke-fume exhaust system including a room air circulation system of the type that normally mixes source or conditioned air with room recirculated air. A detector responsive to the presence of smoke and fumes in the room causes the air circulation system to change the direction of air flow therethrough exhausting the room of the smoke and fumes as by actuating a first damper which isolates the blower from source air so that it only draws room air, and also actuating a second damper which directs the blower exhaust into a bypass duct.

In the case of multiple rooms, the detector sensing smoke and fumes in one room may be used to control the air flow through systems of adjacent rooms in such a manner that the systems of adjacent rooms only admit source or outside air, which pressurizes the adjacent rooms preventing the spread of smoke and fumes to the adjacent rooms.

12 Claims, 5 Drawing Figures



3 Sheets-Sheet 1

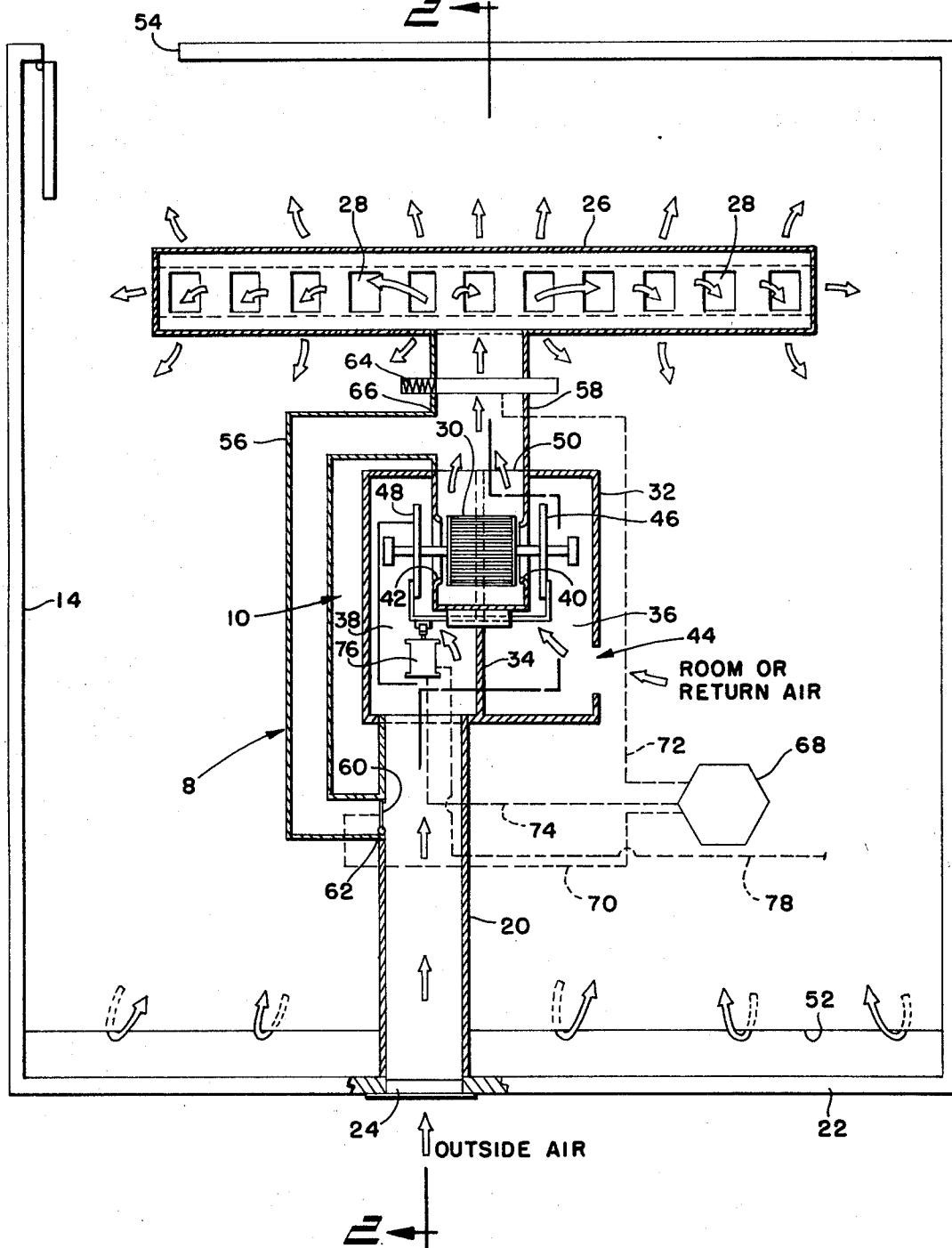


Fig. 1

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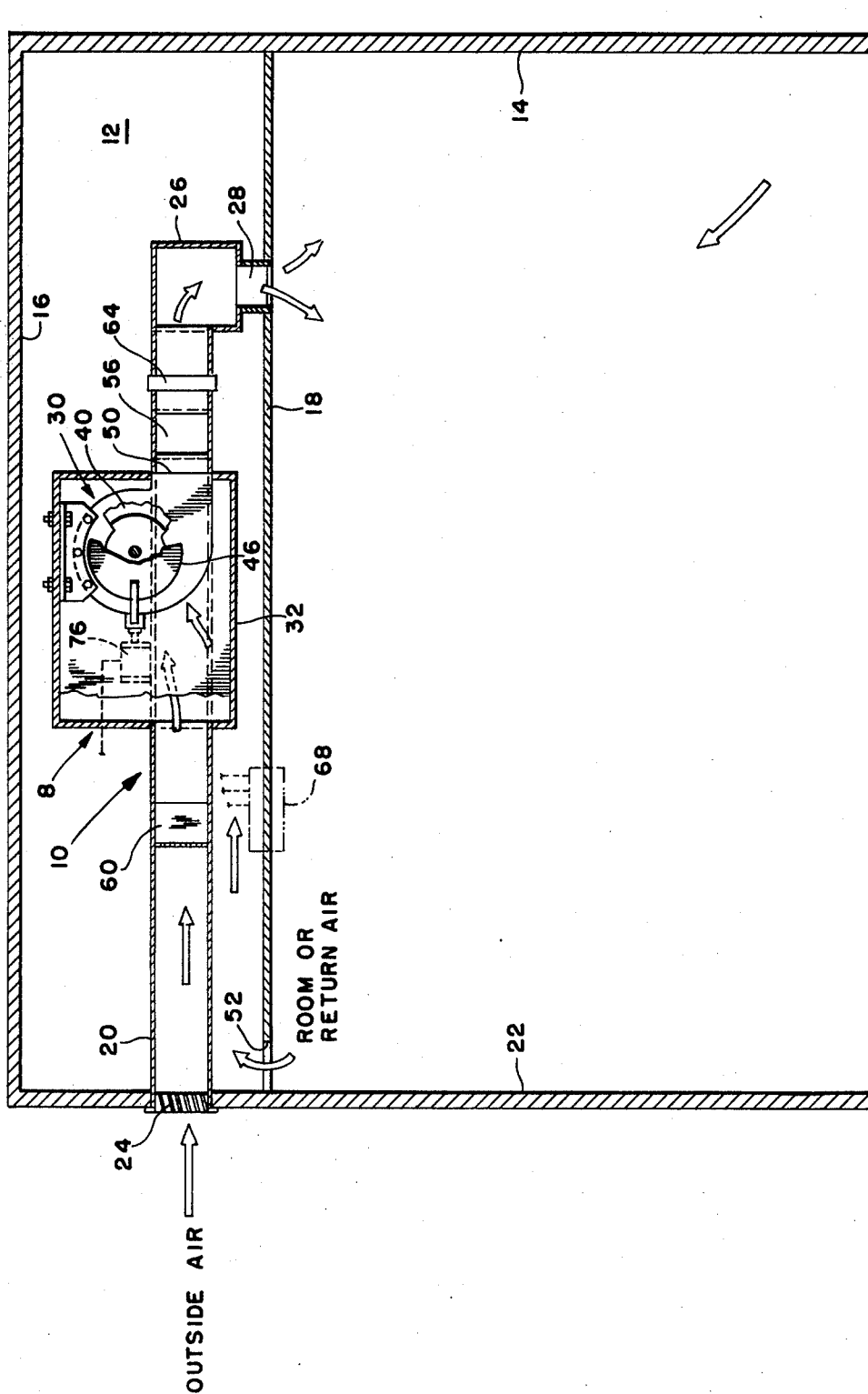
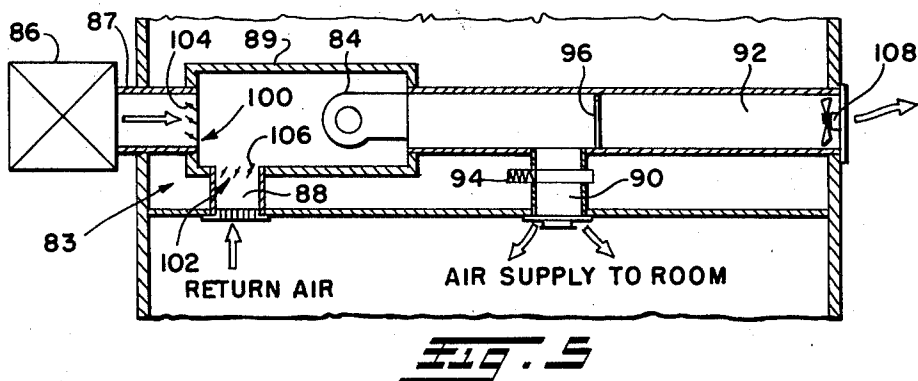
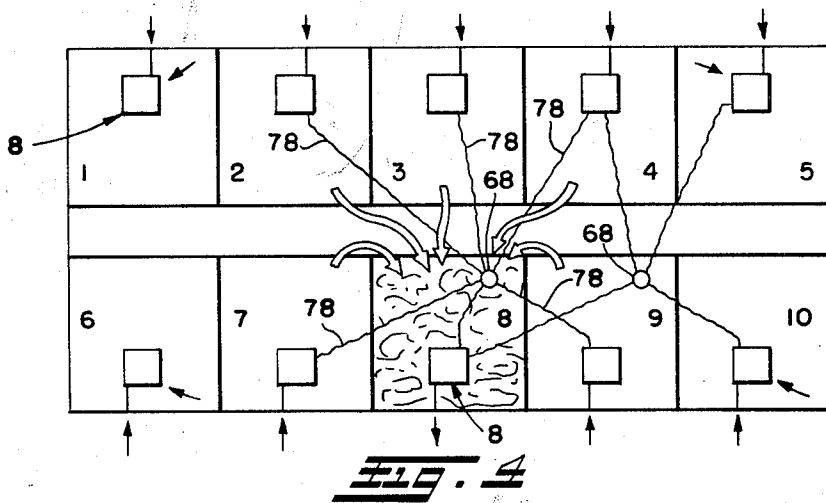
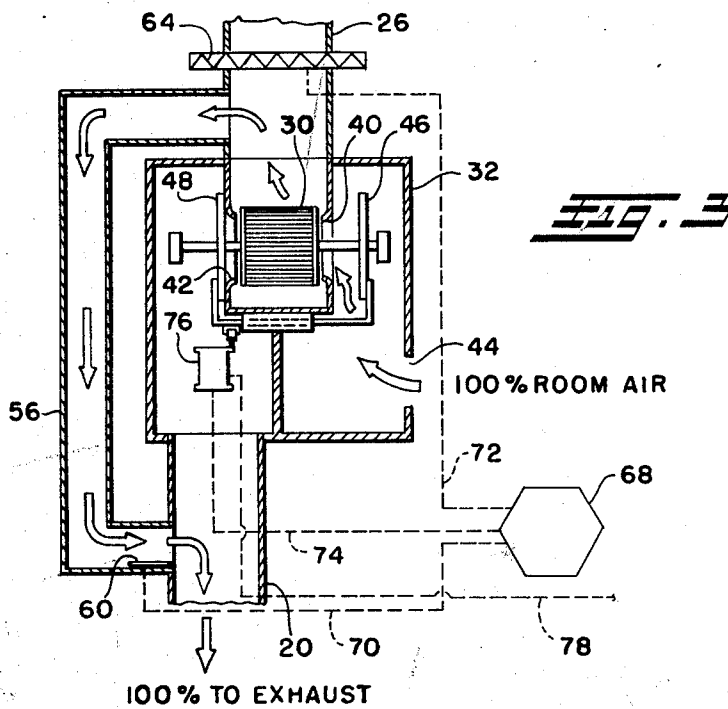


Fig. 2



SMOKE-FUME EXHAUST SYSTEM

BACKGROUND OF THE INVENTION

This invention relates generally as indicated to a smoke and fume exhaust system which may incorporate a conventional air circulation system at a substantial savings.

This invention is particularly applicable to room air circulation systems which mix outside air or conditioned air with room air in the desired proportions and introduce such air into the room. An example of such an air circulation system may be found in U.S. Pat. No. 3,625,629, granted to Thompson Morrison on Dec. 7, 1971, but it will be appreciated that the smoke-fume exhaust system of the present invention may also incorporate other known types of air circulation systems.

It is well known that the greatest danger to life from fires is inhalation of smoke and toxic fumes. Present methods and systems for exhausting smoke particularly from rooms of older buildings are inadequate, and in some cases, where there are multiple rooms, such as in offices and school buildings, the usual air circulation systems may even contribute to the spread of smoke and fumes throughout the structure. Moreover, to provide such offices and school buildings with an adequate system for exhausting smoke and fumes has heretofore generally been prohibitively expensive and impractical.

SUMMARY OF THE INVENTION

With the foregoing in mind, it is a principal object of this invention to provide an improved method or system for exhausting or removing smoke and fumes from a space, such as a room, in the event of fire.

Another object is to provide such a method or system for removing smoke and fumes which may be made relatively inexpensive as by incorporating, where possible, existing air circulation systems.

Still another object is to provide such a smoke-fume exhaust system for a structure having multiple rooms in which the smoke and fumes in the immediate area of the fire are exhausted, and the surrounding area is pressurized to confine the smoke and fumes to the area of the fire.

These and other objects of the present invention may be achieved by using a conventional air circulation system which normally mixes return or room air with conditioned or outside air in the desired proportions and discharges such air into the room, and providing suitable means for redirecting the flow of air through the system to exhaust smoke and fumes from any area where detected. At the same time, means may also be provided for pressurizing the surrounding area thereby confining the smoke and fumes to the immediate area of the fire.

Preferably, each air circulation system includes a blower which proportionally mixes a source air, either outside air or air from a central ducted source, with room circulated air. A detector in the immediate area of the fire actuates a plurality of dampers which isolate the blower in the area to be exhausted from the source air so that the blower only exhausts room air. The same detector may also be used to actuate the dampers of other smoke-fume exhaust systems in the surrounding area in such a manner that the other systems only introduce source or outside air into the other area for pressurizing such other areas.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the invention may be employed.

BRIEF DESCRIPTION OF THE DRAWINGS

In the annexed drawings:

FIG. 1 is a schematic top plan view partly in section of a room smoke and exhaust system constructed in accordance with the present invention;

FIG. 2 is a longitudinal section through the system of FIG. 1 taken along the plane of the line 2—2 thereof;

FIG. 3 is a partial top plan view of the smoke exhaust system of FIG. 1 illustrating the operation of the system in the event of a fire or the presence of smoke or fumes;

FIG. 4 is a schematic plan view showing the system of the present invention incorporated in a structure having multiple rooms; and

FIG. 5 is a partial longitudinal section through a modified form of smoke-exhaust system constructed in accordance with this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now in detail to the drawings and first especially to FIGS. 1 and 2, there is shown a preferred form of smoke-fume exhaust system 8 including an air circulation system 10 positioned within a plenum 12 of a room or enclosure 14 formed between the ceiling 16 thereof and a false ceiling 18. The air circulation system 10 may be of conventional type including an intake duct 20 which may extend through an outside wall 22 of the room or enclosure to provide communication with the outside through a louver 24 and a distribution duct 26 which may have a plurality of openings 28 therein for discharging air from the system into the room 14.

A blower 30 may be positioned within a housing 32 to which the air intake duct 20 and distribution duct 26 are connected. An intermediate wall 34 of the housing 32 divides the housing into separate plenum chambers 36 and 38 which are communicated with by the opposite intake openings 40 and 42 of the blower 30. The plenum chamber 36 is also in communication with the room 14 through housing opening 44, whereas the plenum chamber 38 is in communication with the air intake duct 20. Accordingly, the blower 30 is capable of drawing air both from the room 14 through the housing opening 44 and from the outside through the air intake duct 20. Dampers 46 and 48 may also be provided for varying the amount of outside or conditioned air and room air drawn into the blower. As shown in FIG. 2, the discharge opening 50 of the blower 30 is in communication with the distribution duct 26 for discharging the proportioned air into the room.

Such a housing and blower assembly may be of the type disclosed in the aforementioned U.S. Pat. No. 3,625,629, which is incorporated herein by way of reference. However, it will be apparent that blowers or air blenders of types other than that shown in U.S. Pat. No. 3,625,629 may also be employed. It will also be apparent that the blower may be in communication with a central ducted source serving a number of proportional

blower units, rather than directly in communication with the outside through louver 24 as shown. Such a proportional blower is capable of blending air from various sources to supply a desired mixture of constant volume during modulation of one or both of the blower inlets. When used for ventilating purposes, the blower of U.S. Pat. No. 3,625,629 permits full modulation up to 100% outside air to permit maximum use of natural cooling, and such blower also permits modulation of up to 100 percent room air.

As best seen in FIG. 2, the flow of room air into the plenum chamber 12 above the room false ceiling 18 preferably is through an opening or slot 52 in the false ceiling 18 removed from the distribution duct openings 28.

In accordance with the concepts of the present invention, the air circulation system 10 has a bypass duct 56 around the housing 32 providing communication between the distribution duct 26 and air intake duct 20. A damper 60, which may be located at the point of connection 62 between the air intake duct 20 and the bypass duct 56, is normally closed preventing the flow of air through the bypass duct. A smoke damper 64 is also provided in the distribution duct section 58 downstream of the point of connection 66 of the bypass duct 56 with the section. However, the smoke damper 64 is normally open permitting unobstructed flow of air from the blower discharge opening 50 into the room through the distribution duct 26.

Suitably electrically connected through leads 70 and 72 to the bypass damper 60 and smoke damper 64, respectively, is a smoke detector 68. The smoke detector 68 may also be connected through lead 74 to an actuator 76 for moving the blower dampers 46 and 48 to a position providing for the return of substantially 100% room air to the blower 30 when the smoke detector detects the presence of smoke or fumes for a purpose to be described more fully hereafter.

Preferably, a fusible link, capable of melting when subjected to heat, for instance, 165°F, or to an electrical impulse of low power and short duration typically supplied by a smoke detecting device, is used to hold the bypass damper 60 in a normally closed position. However, the bypass damper 60 is spring loaded to open when the link melts either from an electrical impulse from the smoke detector 68 or from heat. The smoke damper 64 is also held in an open position by a fusible link, and is spring loaded to close on melting of the link either from an impulse from the smoke detector or from local heat.

During normal operation, the bypass damper 60 is closed and the smoke damper 64 is open permitting the blower to mix outside or conditioned air and room air in the desired proportions and discharge the air into the room through the discharge duct 26 as shown in FIGS. 1 and 2. However, if a fire should occur, the smoke and fumes will cause the smoke detector 68 to produce in known manner an electrical impulse which melts the fusible links for the bypass damper 60 and smoke damper 64 causing the former to open and the latter to close. The electrical impulse from the smoke detector also actuates the damper actuator 76 causing the blower dampers 46 and 48 to shift to the right as shown in FIG. 3 closing blower intake 42 and fully opening blower intake 40 so that substantially only room air is drawn into the blower 30 and transmitted through the bypass duct 56 for discharge to the outside through the

air intake duct 20, thereby exhausting the smoke and fumes from the room.

FIG. 4 illustrates application of the present invention to multiplicity of rooms, zones or areas. As schematically shown, each room has its own smoke-fume exhaust system 8 including an air circulation system capable of introducing outside or conditioned air directly or from a central ducted source into the room. In the event of a fire in one of the rooms, as for example in room 8, the smoke detector 68 in that room will close the smoke damper and open the bypass damper of the room unit so that the latter exhausts substantially 100 percent room air to the outside as previously described.

Moreover, by connecting the smoke detector 68 of room 8 by leads 78 to the air circulation units of adjacent rooms 2, 3, 4, 7 and 9 as schematically shown in FIG. 4 and more particularly shown in FIG. 1, the actuator 76 may be caused to move the blower dampers 46 and 48 of the air circulation units of adjacent rooms to a position shutting off the flow of room air to the units and providing for the discharge of substantially 100% outside or conditioned air to the adjacent rooms to pressurize the adjacent rooms preventing smoke and fumes from the affected area to be drawn into the adjacent rooms, and confining the smoke and fumes to the affected area. Of course, if one or more of the adjacent rooms are also affected by smoke and/or fire, the smoke detector 68 of the additional affected adjacent rooms may be made to override the signal received from the other affected rooms to cause the additional affected rooms also to exhaust substantially 100 percent room air as previously described.

FIG. 4 shows leads 78 extending from the smoke detector 68 of two of the rooms to the units of adjacent or contiguous rooms. However, it will be apparent that the systems of any number of rooms may be similarly connected together as desired. Of course, the air circulation units of those rooms not connected to the affected rooms will maintain normal operation as previously described.

In FIG. 5 there is illustrated a modified form of smoke-fume exhaust system 83 in accordance with the present invention including a blower 84 which receives outside or conditioned air from a conventional air conditioning unit 86 through an intake duct 87. A room or return duct 88 is also connected to the blower housing 89, whereas a conventional air distribution duct 90 is connected to the exhaust side of the blower.

In this example the bypass duct 92 connects with the distribution duct 90 and communicates directly with the outside rather than through the intake duct 87. In the case of fire and smoke or fumes in the room, a smoke damper 94 positioned in the distribution duct 90 automatically closes, and a bypass damper 96 in the bypass duct 92 automatically opens as previously described.

The blower 84 is shown positioned in a plenum chamber or housing 89 which has separate openings 100 and 102 in communication with the air conditioner 86 and room or intake duct 88. Adjustable mixing dampers 104 and 106 may be positioned in these openings to proportion the amounts of room or return air and conditioned air transmitted to the blower instead of using a proportional blower of the type shown and described in the aforementioned U.S. Pat. No. 3,625,629. Similar adjustable mixing dampers may also be provided in the inlet 44 and intake duct 20 of the

smoke-fume exhaust system of the FIGS. 1 through 3 embodiment in lieu of the dampers 46 and 48 or as a supplement thereto as desired. As a further alternative, a secondary exhaust fan 108 may be installed in the bypass duct or at a remote location, and can be energized as a booster exhaust means if desired.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A smoke exhaust system comprising a room air circulation system including a blower, means for introducing source air and room recirculated air to said blower for mixing of such air in the desired proportions prior to discharge from said blower into the room, a smoke detector, first means responsive to the detection of smoke by said smoke detector for isolating the blower from the source air so that substantially only room recirculated air passes through said blower, and second means responsive to the detection of smoke by said smoke detector for directing the air discharge from said blower away from the room to the outside thereby exhausting the room of smoke.

2. The system of claim 1 wherein said blower is a proportional blower including openings for admitting the source air and room recirculated air and damper means for varying the size of said openings to vary the amount of such source air and room recirculated air admitted to said blower.

3. The system of claim 1 wherein damper means are provided for controlling the relative amounts of source air and room recirculated air admitted to said blower.

4. The system of claim 1 wherein there are a plurality of said room air circulation systems for a structure having multiple rooms, each room having an individual air circulation system, and means are provided for isolating the blowers of selected rooms adjacent a room affected by smoke so that the blowers of such selected rooms receive only source air for pressurizing the adjacent rooms.

5. The system of claim 4 wherein said last-mentioned means comprises means responsive to a signal from the smoke detector of a room in which smoke is detected to cut off the flow of room air to the blowers of adjacent rooms so that the blowers of adjacent rooms receive substantially 100 percent source air.

6. In a room circulation system of the type including a blower having first and second intake openings and an exhaust opening, a source air connection in communication with the first opening, a room air connection in communication with the second opening, and air distribution means in communication with the exhaust opening, the improvement comprising a bypass also in communication with the blower exhaust opening, a smoke detector, first means responsive to the detection of smoke by said smoke detector for isolating the air distribution means from the blower exhaust opening,

and second means responsive to the detection of smoke by said smoke detector for isolating the blower first opening from the source air connection, whereby, on detection of smoke, the blower only discharges room air through said bypass to exhaust the room of smoke.

7. The system of claim 6 further comprising closure means normally closing said bypass, and means responsive to the detection of smoke by said smoke detector to open said closure means to permit the passage of air through said bypass.

8. The system of claim 7 further comprising damper means for controlling the relative amounts of source air and room recirculated air admitted to said blowers.

9. A fume and smoke exhaust system comprising an air circulation system for mixing source or conditioned air with recirculated air and discharging such air after mixing into an area, a smoke and fume detector for such area, and means responsive to the detection of smoke by said smoke and fume detector for converting said air circulation system to an exhaust system for exhausting such area of smoke.

10. The system of claim 9 wherein there are a plurality of said air circulation systems for each area of a structure having multiple areas to be exhausted, and means are provided for converting the air circulation systems of areas contiguous to the smoke or fume containing area substantially entirely to introduction of source air into the areas, said last-mentioned means pressurizing the areas and thereby confining the smoke and fumes to the smoke and fume containing area.

11. A smoke exhaust system for multiple areas of a structure comprising an air circulation system for each area, each said air circulation system comprising a blower for mixing source air and area recirculated air and discharging the same into said area, a bypass duct for each area, a smoke detector for each area associated with the air circulation system therein, each system further including first means responsive to the detection of smoke by the smoke detector associated therewith the directing the flow from the blower thereof into said bypass duct and for isolating the blower from source air so that the blower receives only area recirculated air, and second means responsive to the detection of smoke by an adjacent area smoke detector for isolating the blower thereof from area recirculated air so that the blower receives only source air thereby pressurizing the area.

12. The exhaust system of claim 11 wherein each said blower is a proportional blower having first and second intake openings, a plenum chamber in communication with each opening, and damper means for opening and closing said openings for proportioning the flow of air therethrough, one of said openings being in communication with source air and the other of said openings being in communication with recirculated air.

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