The invention relates to protection against fumes resulting from fires in buildings. When a fire occurs in a building and fatalities result, most of these casualties are the result of breathing fumes, such as smoke, toxic gases and highly heated gases, due to the fire. Where there is a connecting opening between one portion of a building and another, such fumes from a fire in one may spread to the other through the opening. This is especially true in multistory buildings where openings are provided to enable people to go from one floor to another, as for example the wells shafts of moving stairways, stairwells, entrances to elevator hoistways and the like. Thus, fumes from a fire on one floor may rise to floors above through the moving stairway wells, creating a hazard to people on such floors above, which may prove fatal even though the fire does not reach these floors. Also such fumes in these wells prevent the use of the stairways during the fire. Similarly, in the case of a stairwell, especially when used for emergency exit, the passage of such fumes into this well defeats its purpose with the possibility of trapping people attempting to use it as a means of escape. In the case of elevator hoistways, the filling of them with such fumes renders them useless.

The object of the invention is to prevent fumes due to a fire from passing from the portion of a building in which the fire occurs through a connecting opening to another portion of the building.

One feature of the invention resides in diverting fumes from an opening connecting one portion of a building with another, by exhausting them out of the outdoors.

Another feature involves drawing air through the opening in a direction to oppose the flow of fumes through the opening.

Another feature involves spraying water across the path of the fumes as they approach the opening.

Still another feature involves preventing air from an outdoor wall opening of the building on a level with or below the connecting opening being fed to the exhaust system to such extent as to prevent the drawing of air through such connecting opening in a direction to oppose the fumes. In carrying out the invention according to the arrangement which will be described, a duct is provided for each opening, positioned around the opening when in the ceiling and above the opening when in a side wall. The duct is provided with apertures through which the fumes may flow into the duct when a fire occurs. These ducts serve as collection ducts and lead through connecting ducts to an exhaust duct common thereto. Each connecting duct is provided with a damper. An exhaust fan which discharges outdoors has its inlet connected to the exhaust duct. When a fire starts the damper in the connecting duct for the portion of the building in which the fire starts is opened and the exhaust fan is started in operation. The fan draws air through the opening in a direction to oppose the flow of fumes, this air being drawn into the collection duct and, with fumes from the fire, external application, discharged outdoors. The air for opposing the flow of the fumes through the opening is supplied from an overhead fresh air intake and is drawn through the opening by the action of the exhaust fan. The fresh air intake is also provided with a damper which is opened along with the starting of the exhaust fan in operation. Where a connecting opening is normally closed, a fresh air access may be provided.

A sprinkler system is utilized to spray water across the path of the fumes. It is preferred to arrange the sprinkler system to form a water curtain which, by its cooling action, obstructs the passage of fumes into the opening by convection, fumes which pass the curtain being drawn into the collection duct. It also prevents flame passing into the collection duct.

The exhaust system for the portion of the building in which a fire occurs is started in operation automatically, as by thermal responsive devices or smoke detecting devices. The invention is especially applicable to sprinkled buildings. In such structures, upon the starting of a fire, one or more of the sprinkler heads near the fire are automatically set off to fight the fire. In applying the invention to such structures, the turning on of the water may be utilized to start the exhaust system in operation with respect to the portion of the building in which the fire exists. The water curtain for an opening may be set off by a system of one or more pilot sprinklers, which also may be used to initiate the operation of the exhaust system when the fire starts near the opening.

The sprinkler system may be arranged to provide a water deluge for the connecting opening. Such arrangement has especial application to stairwells or to wells of moving stairways. For this purpose sprinkler heads of the high velocity water jet type are utilized and positioned so as to provide a concentrated water application over an entire cross section of a stairway.
This arrangement may be used to supplement the water curtain sprinklers, particularly where there is the possibility of flash fires at the opening.

To prevent air entering the building through an outdoor wall opening, such as an outdoor exit on the ground floor, from supplying air to the exhaust system to such extent as to interfere with the drawing of air through the connecting opening in a direction to oppose the fumes, a fan is provided at the outdoor opening which acts to draw off air which tends to enter the building at the point and discharge it back into the outdoors. This fan is started in operation at the same time as the exhaust system.

Where the building is provided with moving stairways, the moving stairways serving the portion of the building where the fire occurs, or all the moving stairways, are shut down automatically along with starting the exhaust system in operation. Where the building is provided with a ventilating system, such as air conditioning, this system is shut down automatically with the starting of the exhaust system.

A general idea of the invention, the mode of carrying it out which is at present preferred, and various advantages thereof will be gained from the above statements. Other features and advantages of the invention will be apparent from the following description and appended claims.

In the drawings:

Figure 1 is a schematic representation in perspective, with parts broken away, of an embodiment of the invention, including an exhaust system and a water curtain sprinkler system, applied to the wellway openings for moving stairways in a multistory building;

Figure 2 is a diagrammatic view in vertical section of a deluge sprinkler arrangement along the length of a moving stairway;

Figure 3 is a fragmental diagrammatic view in vertical section of a protecting fan arrangement for an outdoor exit for the building;

Figure 4 is a schematic wiring diagram for an installation such as shown in Figure 1 and embodying the protecting fan of Figure 3;

Figure 5 is a diagrammatic bottom view of an exhaust and water curtain sprinkler system as applied to the wellway openings of a cross-class moving stairway arrangement; and

Figure 6 is a schematic representation in vertical section of an exhaust and water curtain sprinkler system applied to an elevator hoistway.

The invention will first be described as applied to the moving stairway wellway openings of a multistory building. Referring to Figure 1, a five floor building is illustrated, the floors being designated 1, 2, 3, 4 and 5. Moving stairways 8 serve these floors, extending between floors 1 and 2, floors 2 and 3, floors 3 and 4 and floors 4 and 5. For convenience in illustrating the stairways, these stairways are shown in non-continuous arrangement for one direction of travel. Also, they are shown near a wall but it is to be understood that they would be positioned in accordance with the requirements of the particular installation.

Each moving stairway has a wellway opening 1 communicating with the floor above. Depending from the ceiling around each wellway opening is a collection duct 8. This duct is positioned like a smoke apron, forming an obstruction on each of the two sides and the open end of the wellway opening with the stairway itself completing the obstruction at the other end. The collection ducts are illustrated as having right angle bends but other constructions such as a semi-circle at the open end may be used. Slots 16 are provided along the outer walls of the duct near the bottom to form a passage for the fumes. Each collection duct is connected by a duct 11 with an exhaust duct for five 12 common to the collection ducts. The connecting ducts are illustrated as joined to the centers of the end portions of the collection ducts.

The exhaust duct is illustrated as extending along a wall but it may be positioned outside the building.

Each connecting duct is provided with a damper 13, illustrated as latched in closed position but biased for movement to open position upon release of the latch. The bias is provided by the unbalanced weight of operating arm 14. A pin on this arm is engaged by the plunger of a release electromagnet 15 to latch the damper closed. Energization of the electromagnet withdraws the plunger to release the arm, allowing the damper to open.

The exhaust duct 12 leads to an exhaust fan 16 on the roof 17 of the building. This fan is driven by an electric motor 18. Suitable weather protection, such as louvers not shown, may be provided for the discharge opening of the fan. The size of the fan and the ducts depends upon the size of the wellway openings, it being understood that the fan and ducts are of sufficient capacity to insure the desired down draft through the openings.

A fresh air intake is provided in the roof of the building above the moving stairway wellway openings. This intake comprises a cupola 20 over the intake opening 21, the side walls of the cupola being provided with louvers 22 to admit the fresh air and to form weather protection for the intake opening. The intake opening is provided with a damper 23 illustrated as biased by its own weight to open position and arranged to be latched closed, as by the plunger of a release electromagnet 24 engaging a pin on the end of the operating arm 25 for the damper. For convenience, the damper is illustrated as positioned below the ceiling but it is to be understood that the mechanism may be located in the cupola with the intake opening flush with the ceiling and provided with an ornamental protecting grille. Also, instead of the damper, the louvers themselves may be operated to open and close their openings. Also, instead of the fresh air intake being in the roof or ceiling, it may be arranged in one of the outer walls of the building.

A sprinklered building is illustrated in Figure 1, this being indicated by a plurality of sprinkler heads 27 distributed at various points on the ceilings for floors 1, 2, 3 and 4. These sprinkler heads are of the thermo-responsive type, for example, to be set off automatically as by fusible links. The setting off of any of these sprinkler heads starts the exhaust system in operation for the floor for which the sprinkler head is provided. Sprinkler head 27 may be utilized on the fifth floor for playing on any fire which may start on that floor. Other automatic controls may be provided to start the exhaust system in operation. Such controls are indicated at 28 for floors 1, 2, 3 and 4 and may be in the form of thermo-responsive devices, smoke detecting devices and the like. Also a manual control 30 may be provided at each
of floors 1, 2, 3 and 4 for starting the exhaust system in operation with respect to that floor. A plurality of additional sprinkler heads 31 are positioned around and on the outside of the collection duct for the wellway opening for each of floors 1, 2, 3 and 4. The sprinkler heads 31 are of the open type and provide an umbrella-like spray. They are spaced apart so that their sprays meet a short distance below the slot in the collection duct wall. They are spaced close enough to the collection duct that some of the spray hits the floor and thus may be drawn into the duct to exert a cooling action. These sprinkler heads are controlled by pilot sprinklers 32 positioned to be responsive to temperature at either side or end of the collection duct. The arrangement is such that upon any pilot sprinkler letting go, all the sprinkler heads 31 are turned on to seal off the opening with a water curtain.

The exhaust and sprinkler system has been illustrated in Figure 1 as applied to a non-continuous stairway arrangement because the system is more readily seen from the illustration with such a stairway arrangement. The system is similarly applied to other moving stairway arrangements. As an example, the system is diagrammatically illustrated in Figure 5 for the wellway openings in a ceiling for a cross arrangement of moving stairways extending to the floor below. Here the wellway openings are designated 35 and 36. The stairways for which these openings are provided are indicated in dotted lines and are designated 37 and 38.

One collection duct 40 is provided for both openings and extends in the form of a loop all the way around the openings. A connecting duct 42 connects the collection duct to exhaust duct 12 along the outside wall 45 of the building, a damper 13 being provided in the connection duct. Mechanism, not shown, is provided for automatically opening the damper as in Figure 1. The collection duct is tapered to provide a uniform intake volume at any point in the duct. This taper, for the particular arrangement in Figure 5, starts at a point 41, opposite the point of juncture to the connection duct 42, and extends in each direction from point 41 to the connection duct. tapered collection ducts are also provided in the arrangement of Figure 1 but are not readily indicated in the perspective arrangement illustrated.

The sprinkler heads 31 for the water curtain are positioned around the collection duct and close enough thereto that some of the water which is sprayed toward the stairways hits the duct, thereby resulting not only in some of the water being taken into the duct system for cooling but also in the water curtain extending substantially straight down from the outer side of the collection duct. By having the water curtain substantially straight down on the stairway side and by positioning the collection duct and water curtain sprinkler heads to encompass a space 44 extending well beyond the ends of the stairways as indicated, the stairways and the transfer floor area at the ends of the stairways are kept dry, enabling people to use the stairways during an emergency without getting wet. With a cross-cross arrangement, there is beneath each of stairways 37 and 38 another stairway extending parallel thereto between the ends of the stairways and the floor next below this floor. Thus, transfer between stairway 37 and the stairway beneath stairway 38 and transfer between stairway 38 and the stairway beneath stairway 37 can be made inside the water curtain.

The water supply system is also illustrated in Figure 5. In the arrangement illustrated, the sprinkler heads 31 are fed through a continuous pipe 45. This pipe is connected by a pipe 47 to a flooding or deluge valve 48. This valve is connected to the main water supply pipe 50 by way of pipe 51. Valve 48 is controlled by the pilot sprinklers 32. These pilot sprinklers are positioned to be responsive to heat at any point in the vicinity of the wellway openings and are illustrated as positioned along each side of the space 44, one midway and one at each end. Other arrangements may be used including those in which a pilot sprinkler is positioned at each end of space 44 and midway thereof. The pilot sprinklers are fed by a pipe 53 connected through pipe 54, valve 43 and pipe 41 to supply main 55. The valve 43 is normally open to the pilot sprinklers 32 but closed to the sprinkler heads 31. This arrangement is such that should any pilot sprinkler react, valve 43 acts automatically to shut off the supply of water to the pilot sprinklers and to permit the water to flow to the sprinkler heads 31. As the sprinkler heads 31 are of the open type, all of them spray water so that a water curtain is formed. A flow valve 56 is arranged in pipe 51 and is arranged to operate a switch, shown in Figure 4, should the flow of water take place in pipe 51 from the supply main. This switch acts, as will be explained in discussing Figure 4, to start the exhaust system in operation for the wellway openings 35 and 36. A similar water supply arrangement is provided for each wellway opening, or encompassed space 44, for associated openings, for each of floors 1, 2, 3 and 4 of Figure 1.

Automatic sprinkler heads 27 are also shown in Figure 5 as indicative of a sprinklered building arrangement. These heads are fed by a pipe 66, joined to pipe 51 so that their supply of water must actuate the flow valve 56. Thus, should a fire occur at any point away from the encompassed space 44, the nearest sprinkler head or heads 27 would automatically react to fight the fire and in so doing would actuate the flow valve 56 to start the exhaust system in operation for wellway openings 35 and 36. A similar arrangement is provided for each of the floors 1, 2, 3 and 4 of Figure 1 in a sprinklered building.

Referring now to Figure 3, 60 represents a vestibule between the interior 61 of the building and the outdoors. 62 is an outer door while 63 is an interior door. A passage 64 is provided in the ceiling of the vestibule leading to the intake of a fan 65. The discharge 66 of the fan leads to outdoors. The fan is driven by an electric motor 67.

Reference may now be had to Figure 4 which is a schematic wiring diagram in semi-"across-the-line" form for the protective system of Figures 1 and 3. The supply lines for the system are indicated as + and -. 68 is a main line switch for connecting the circuits to the supply lines. The motor 18 for driving the exhaust fan 16 for the exhaust system is indicated by its armature and shunt field windings 86. The motor 67, for driving the fan above the vestibule in Figure 3, is indicated by its armature and shunt field winding. These motors are fed from emergency supply lines which are insulated from fire, these lines being designated B+ and E-. The release electromagnet for dual damper 24 as in Figure 1. 70 is an automatic device for sending in an alarm to the fire department. 71 is an electromag-
neristic switch for controlling the ventilating system. 72, 73, 74, 75, 76 and 71 are contacts of a switch 78 illustrated as of a type which may be manually set and held by a latch 79 in second condition. 80 is an electromagnetic release coil for 81 is a manually operable change-over switch. The mechanism thus far indicated is common to the various floors.

The operating and control mechanisms individual to the various floors are for the most part the same. Therefore, except for the differences, these mechanisms for only one floor will be pointed out, differentiation being had as to floors by appending to the reference characters employed a numeral in parenthesis corresponding to the floor for which the mechanism is provided. As a further differentiation aid, these mechanisms are separated by dot-dash lines extending across the sheet. These lines are indicated by numerals in parenthesis in accordance with the various floors. Thus, the mechanism for the second floor, for example, is found between dotted lines (2) and (3).

The operating and control mechanisms for each floor comprise contacts 83 of a switch operated by the flow valve 56 for that floor, a thermally responsive switch 26 as indicative of one or more switches other than the flow valve switch automatically actuated in response to a fire, and a manually operable switch 30, all of which are connected in parallel. These switches control the electromagnetic release coil 86 for the latch 87 for a plural contact switch 88 of a type similar to switch 18, Switch 88, except the one for the first floor, has five contacts designated 90, 91, 92, 93 and 94, contacts 94 not being provided on the switch for the first floor. Contacts 92 of all of these switches are connected in parallel and control the circuit for the release coil 86 for latch 73 of switch 78. Contacts 91 of all of these switches also are connected in parallel and control the circuits for the alarms 95, one for each floor including the fifth floor, also connected in parallel. Contacts 90 control the release electromagnet 15 for the damper in the connecting duct for the corresponding floor. Contacts 93 control the coil of an electromagnetic switch 96 having contacts 91 and 95 arranged in the circuits for the moving stairways extending from the particular floor to the floor above. Although only one moving stairway is shown for each floor in Figure 1, each switch 96 is shown as having two pairs of contacts, to illustrate that one pair may control an up moving stairway to the floor above and the other pair a down moving stairway from the floor above. These contacts may be connected in the circuits for the coils of the potential switches for the particular stairways. Contacts 94 are connected in series with contacts 93 of the switch for the floor below. The latching type switches 78 and 86 are indicated as latched in operated condition while the electromagnetically operated switches 71 and 86 are illustrated in deenergized condition.

In operation, assume that main line switch 66 is closed. This causes switch 71 to be operated. It also causes each of switches 96 to be operated. Assume also that change-over switch 81 is closed. Referring now to Figure 1, assume that a fire occurs on the second floor at 109. The adjacent sprinkler head 27 reacts to play water upon the fire as indicated. The resultant flow of water in the direction indicated by the arrow 101 (2) in Figure 4 actuates the second floor flow valve 56(2) to close contacts 89(2). This completes 75 a circuit for the release coil 86(2) of second floor switch 88(2). The energization of this coil attracts latch 87(2) to release contacts 90(2), 91(2), 92(2), 93(2) and 94(2) to complete the circuit for the release coil 15(2) for the damper 13 in the second floor connection duct. This coil acts to release the latch for this damper, permitting the damper to open. Contacts 92(2) engage to complete a circuit for the release coil 90 of switch 78. This attracts latch 79 to release contacts 73, 74, 75, 76 and 77. Contacts 74 engage to complete a circuit for the release coil 24 for fresh air intake damper 23. This coil acts to release the latch for this damper permitting the damper to open. Contacts 72 engage to complete a circuit for the operating motor 18 for the fan for the exhaust system. Thus, as soon as a fire occurs, the exhaust system is started in operation for the floor on which the fire is located.

At the same time that the exhaust system is being started in operation, contacts 75 engage to complete a circuit for the automatic device 70 to send in the alarm to the fire department. Also, contacts 91(2) engage, completing a circuit for the alarms 95 on all floors. Also contacts 73 engage to complete a circuit for the operating motor 67 for the fan over the vestibule in Figure 3. Also contacts 76 separate to deenergize the coil of switch 71, shutting down the ventilating system. Also contacts 93(2) and 94(2) separate to deenergize the coils of switches 96(2) and 96(1) respectively. These switches drop out to separate their contacts 97 and 98, shutting down the moving stairways extending from the second floor to the third and first floors.

Thus, as a result of reaction of the particular sprinkler head 27, water is locally applied to the blaze to put out the fire, or at least to oppose it until the fire department arrives; the fire department is summoned; an alarm is sounded on each floor to advise people on the floors that a state of fire exists; the moving stairways serving the affected floor are shut down to enable their being used as exits; the ventilating system is shut down; the vestibule fan is started in operation; and the exhaust system as related to the affected floor is started in operation. The exhaust system, upon being started in operation, starts to draw air through the slots 10 into the collection duct 8 and thus acts to create negative pressure in the vicinity of the second floor wellway opening. This induces a down draft from the fresh air intake by way of the superimposed wellway openings through the wellway opening in the second floor ceiling, as indicated by the arrows 102 (Figure 1). The down draft is opposite to the natural direction of flow, opposing any flow of smoke and gases upwardly through these openings. Any smoke or gases which reach the second floor wellway opening are drawn into the collection duct through the slots, being entrained in the air from the fresh air intake and carried off through the connecting duct and exhaust duct to outdoors by the exhaust fan. The vestibule fan acts to carry off air entering the vestibule as a result of people opening the outer door, thus preventing air feeding the exhaust system and interfering with the down draft through the wellway openings. Shutting down the ventilating system also prevents interference with the proper action of the exhaust system and in addition obviates circulation of any smoke and gases throughout the building.

Should the temperature in the vicinity of the
wellway opening reach a certain point, a pilot sprinkler 33 reacts to cause operation of the flooding valve 48 to supply water to the sprinkler heads 31 around the wellway opening. The spray from these sprinkler heads forms a water curtain for the stairway between the second and third floors as indicated. The water of this thick curtain acts to cool the flames which reach the stairway, thereby obstructing their passage into the wellway opening by convection. Fumes which penetrate the water curtain are carried into the duct system and drawn off to the outdoors. Also, the cooling action exerted by the water obviates any flash fires originating at the collection duct. Should the fire originate in the vicinity of the stairway, the water curtain may be set off before any building sprinkler reacts. In this case the flow of water to the water curtain sprinkler heads starts the exhaust system in operation.

After the fire has been extinguished, the water is shut off and any sprinklers which have reacted are restored. Also released latch type switches are manually reset and the operated connecting duct damper and the fresh air intake are closed.

While in the above example of operation it has been assumed that the exhaust system is started in operation by operation of the flow valve 56 for the affected floor, it may be started in operation by the action of a thermal responsive switch 28 in the affected area or some other automatic device such as photoelectric device actuated by smoke. Also the exhaust system may be started in operation manually by the closing of switch 30 for the affected floor. While these other controls may be utilized in a sprinklered building, they are of particular advantage in a partially sprinklered building or a non-sprinklered building.

Also in the above example of operation it has been assumed that change-over switch 81 is closed. With this switch open, contacts 77 of switch 78 are rendered ineffective. As these contacts control the feed common to the coils of all of switches 96, their separation shuts down the moving stairways on all floors. An arrangement similar to that had with switch 81 closed may be employed whereby instead of shutting down the ventilating system for the whole building, only that portion of the system which is connected to the affected area is shut down.

Reference may now be had to Figure 2 wherein a water deluge system for a wellway opening is illustrated. Two moving stairways 6 are shown with a wellway opening 7 for the lower stairway. A plurality of sprinkler heads 106 are arranged along a line crosswise of the soffit 106 of the upper stairway. A plurality of additional sprinkler heads 107 are arranged along another line crosswise of soffit 106. The sprinkler heads are of the high velocity jet type and are controlled by thermal responsive units 108. Sprinkler heads 105 are angled to insure water being sprayed over an area from soffit 106 into a portion of the wellway opening while sprinkler heads 107 are angled to spray water into the remainder of the opening. Thus when the sprinkler heads are set off, there is a deluge of water spray which completely fills the wellway opening as indicated. Also, setting off of the deluge sprinklers starts the exhaust system in operation by the action of the flow valve.

While the deluge system may be used instead of the water curtain, it is preferred to use it more in the nature of a reserve for the water curtain, as to take care of flash fires originating at the stairway, particularly those which would be inside the water curtain. For many installations the deluge system would be omitted.

Although the invention has been illustrated in Figure 1 in conjunction with moving stairway wellway openings, it is similarly applied to other ceiling openings, such as stairwell openings. Also, the invention is applicable to sidewall openings. For example, it is shown in Figure 6 as applied to the hoistway door openings of an elevator installation.

Referring to Figure 6, the elevator hoistway is designated 110, while the elevator car and its counterweight which operate in the hoistway are designated 111 and 112 respectively. The car and counterweight are suspended by hoisting ropes 113 which pass around a hoisting sheave 114 at the top of the hoistway. A three floor installation is illustrated, these floors being designated 115, 116 and 117. 118 is the opening at each floor to provide access to the elevator car and 120 is the hoistway door for closing this opening.

The exhaust system comprises a collection duct 121 on each floor extending across and above the opening 118. The collection duct is provided with an intake slot 122 extending lengthwise thereof near the bottom. Each collection duct is connected by a connecting duct 123 to the exhaust duct 124. The connecting ducts and exhaust ducts are arranged, as at one end of the collection ducts, not to interfere with the operation of the elevator. A damper 125 is provided in each connection duct and may be latched in closed position and automatically opened as previously described. The exhaust duct leads to a centrifugal fan 126 above the hoistway. This fan is driven by an electric motor 121 and discharges to the outdoors, the discharge opening 126 being protected by louvers 130. An air intake 132 is provided at the top of the hoistway. This intake is also protected by louvers 133. It is arranged to be normally closed as by a shutter 134, illustrated as adapted to be raised above the opening through the action of rotating water which is caused to be driven on a drum driven by an electric motor 135. Insufficient air is drawn into the hoistway, since as the hoistway doors are normally closed, a fresh air access 136 is provided at each floor illustrated as arranged in the hoistway door panel at the bottom.

A plurality of open type sprinkler heads 140 are provided at each floor to form the water curtain for the hoistway opening and collection duct. These heads are located along the ceiling in a line parallel to the hoistway wall and are spaced apart so that their sprays meet a short distance below the slot in the collection duct. Also they are close enough to the collection duct so that some of their spray will be drawn into the duct. The sprinkler heads 140 are controlled by pilot sprinklers 141 as previously described. 142 indicates the sprinklers in a sprinklered building. The electric system and the water flow system are not shown but it is to be understood that they may be similar to those in Figures 4 and 5.

In operation, assume that a fire occurs on the second floor at the point 145. The adjacent sprinkler head 142 reacts to play water on the fire as indicated. It also causes the operation of the second floor damper 125, the lifting of shutter 134 from the fresh air intake and the starting of the exhaust fan 126 in operation. The exhaust system starts to draw air into the collection duct above the second floor hoistway opening, inducing
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a down draft of fresh air in the hoistway as indicated by the arrows 146, the fresh air flowing into the second floor through the fresh air access 148. Any smoke or gases which reaches the hoistway are entrained in the air and drawn into the collection duct, the mixed air and fumes being exhausted by the exhaust system. Should the temperature adjacent the hoistway opening reach a certain point, water for sprinklers 148 is turned on and a water curtain is formed across the opening. The water curtain acts to cool the fumes which reach the opening and any fumes which penetrate the curtain are drawn off into the exhaust system. Thus, the elevator hoistway is kept free of smoke and gases to enable the use of the elevator car during the emergency. A similar arrangement of exhaust and water curtain sprinkler system may be employed for other side-wall openings such as those leading into emergency stairwells.

It is seen that with the arrangements described, when a fire occurs the resultant fumes are localized to the area where the fire starts. It has been found by experiment that with some fires, especially where the fire occurs in a sprinkled building and where there is considerable smoke but not so much heat, the exhaust system provides adequate protection without the water system being brought into action. While certain arrangements of duct systems have been specifically described it is to be understood that other arrangements may be utilized including those in which the exhaust duct is common to the collection duct for different openings for the respective floors, as for example, the wellway openings and elevator hoistway openings. Also, the various arrangements for operating the dampers and shutters are by way of illustration and other mechanisms may be employed. Other arrangements may be utilized for exhausting air from exits to prevent interference with the exhaust system. Also other arrangements may be employed for preventing air from an outer wall opening below the affected connecting opening from destroying the opposing air flow through such affected opening, as for example by providing a forced down draft to the connecting openings. Also, other arrangements may be employed for controlling the water curtain sprinklers and for controlling the water deluge sprinklers. Other arrangements of electrical circuits and control and operating mechanism may be employed and, while the system has been illustrated as having direct current supply, it may also be utilized in buildings having alternating current supply.

As many changes could be made in the above constructions and many apparently widely different arrangements of this invention could be made without departing from the scope thereof, It is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in limiting sense.

What is claimed is:

1. A system for protecting one portion of a building against fumes from a fire in another portion having an opening connecting it to the first named portion, said system comprising; a collection duct in said other portion adjacent said opening; an exhaust fan having its inlet connected to said duct and its outlet discharging outdoors; operating means for said fan; an air intake on said one portion side of said opening; and means for causing operation of said fan operating means when such fire occurs to draw air through said opening from said air intake into said other portion to create a draft through said opening to oppose the fumes and with said fumes entrained therewith into said duct and to discharge said air and fumes outdoors.

2. A system for protecting one portion of a building against fumes from a fire in another portion which has an opening connecting with said first named portion, said system comprising; a collection duct for said opening; an exhaust fan having its inlet connected to said duct and its outlet discharging outdoors and adapted upon operation when such fire occurs to draw air and entrained fumes into the duct and discharging the air and fumes outdoors; operating means for said fan; a sprinkler system in said other portion; and means responsive to the reaction of said sprinkler system to such fire to start said fan operating means in operation.

3. A system for protecting one portion of a building against fumes from a fire in another portion which has an opening connecting with said first named portion, said system comprising; a collection duct for said opening; an exhaust fan having its inlet connected to said duct and its outlet discharging outdoors and adapted upon operation when such fire occurs to draw air and entrained fumes into the duct and discharging the air and fumes outdoors; means for driving said fan; a sprinkler system in said other portion, said sprinkler system including a plurality of sprinkler heads; and means responsive to the flow of water to any of said sprinkler heads to start said driving means in operation to drive said fan.

4. A system for protecting one portion of a building against fumes from a fire in a portion below which has an opening in the ceiling connecting it to the first named portion, said system comprising; a collection duct extending around said opening; an exhaust fan having its inlet connected to said duct and its outlet connected to discharge outside the building; operating means for said fan; an air intake for said opening on said one portion thereof and a control for causing operation of said fan by said operating means when such fire occurs to draw air through said opening from said air intake to create a down draft through said opening to oppose the fumes and with said fumes entrained therein into said duct and to discharge said air and fumes outdoors.

5. A system for protecting one portion of a building against fumes from a fire in a portion below which has an opening in the ceiling connecting it to the first named portion, said system comprising; a slotted duct extending around said opening; an exhaust fan having its inlet connected to said duct and its outlet discharging outdoors; means for driving said fan; an intake for providing air to the opening from above; a damper in the connection between said duct and said inlet; and means responsive to the fire for causing opening of said damper and operation of said fan by said driving means to draw air from said air intake through said opening and along therewith fumes from the fire into said duct and to discharge the air and fumes to outdoors.

6. A system for protecting each of a plurality of floors of a multistory building against fumes from a fire on a floor below such floor, each of said plurality of floors having an opening to the floor below, said system comprising; a duct for each opening, each duct extending at least part way around the opening for which it is provided...
and having a slot throughout its length; an exhaust duct common to and connected to said first named ducts; a normally closed damper for each first named duct in the connection thereof to said exhaust duct; an exhaust fan having its inlet connected to said exhaust duct and its outlet discharging outdoors; a driving motor for said fan; an intake for providing air to said openings from a higher point in said building; and means responsive to such fire for causing operation of said motor to drive said fan and opening of said damper for said first named duct for the opening to the floor on which the fire occurs from the floor above.

7. A system for protecting each of a plurality of floors of a multistory building against fumes from a fire on a floor below such floor, each of said plurality of floors being connected to the floor below by an opening in the ceiling of such floor below, which openings are superimposed, said system comprising; an intake for providing air to said openings from above; a collection duct for each opening, each duct extending downwardly from the ceiling in which the opening for which it is provided is located and said opening and having a slot coextensive therewith in its outer wall near the bottom; an exhaust duct common to said collection ducts; a duct for each collection duct connecting said collection duct to the exhaust duct; a damper in each connection duct; an exhaust fan having its inlet connected to said exhaust duct and its outlet connected to outdoors; and means for driving said fan.

8. A system for protecting each of a plurality of floors of a multistory building against fumes from a fire on a floor below such floor, which building has a plurality of superimposed moving stairways, one extending from each of said plurality of floors to the floor below, each stairway having a wellway opening, and which building has heat responsive sprinkler heads on each of such floors below, said system comprising: a collection duct for each opening, each duct extending downwardly from the opening for which it is provided and having a substantially continuous intake slot in its outer wall near the bottom; an exhaust duct common to said collection ducts; a duct for each collection duct connecting said collection duct to the exhaust duct; a normally closed damper in each connecting duct; means for each damper for causing opening thereof; an exhaust fan having its inlet connected to said exhaust duct and its outlet connected to outdoors; a motor for driving said fan; and means responsive to the reaction of a sprinkler head on any one of such floors below on which a fire occurs for causing operation of said damper opening means for the damper in the connection duct for such floor and of said fan motor to cause air to be drawn downwardly through the wellway opening and thence with any fumes from the fire entrained therein into the collection duct on such floor and by way of the connecting duct therefrom and exhaust duct to the fan and be discharged outdoors.

9. A system for protecting one portion of a building against fumes from a fire in another portion having an opening connecting it to the first named portion, which building has an outdoor wall opening on the same level or below said first named opening, said system comprising: an exhaust system for discharging to outdoors entering said outdoor wall opening to thereby prevent substantial interference with the said drawing of air through said first named opening by said first mentioned exhaust system.

11. A fume protection system for a building having an opening connecting one portion of the building with another portion, said system comprising; an exhaust system extending from said opening to outdoors; and a water spray system at said opening, said exhaust system and said water spray system cooperating to effectively prevent the passage of fumes through said opening from one of said portions into the other.

12. A fume protection system for a building which has an opening connecting one portion of the building with another portion, said system comprising; a collection duct for said opening; an exhaust fan having its inlet connected to said duct and its outlet discharging outdoors; and a sprinkler system positioned at said opening to form a water curtain thereof.

13. A system for protecting one portion of a building against fumes from a fire in another portion which has an opening connecting with said first named portion, said system comprising; a collection duct for said opening; an exhaust fan having its inlet connected to said duct and its outlet discharging outdoors and adapted upon operation when such fire occurs to draw air and entrained fumes into the duct and discharge the air and fumes outdoors; a sprinkler system positioned at said opening to form a water curtain therefrom; and means responsive to temperature at said opening for starting said sprinkler system in operation.

14. A system for protecting a floor of a building against fumes from a fire on the floor next below which has an opening in the ceiling connecting it to the first named floor comprising; an apertured duct extending from said opening; an exhaust fan having its inlet connected to said duct and its outlet discharging outdoors; operating means for said fan; an intake for providing air to said opening from above; a sprinkler system for said opening for providing a water curtain thereon to the outside of said duct; and means responsive to a fire on said floor below for causing operation of said fan by said
operating means, said fan and duct being of sufficient capacity to draw air from said air intake downwardly through said opening and with fumes from the fire entrained therein into said duct and to exhaust the air and fumes to outdoors and for causing operation of said sprinkler system when the temperature at said opening reaches a certain point.

15. A system for protecting a floor of a building against fumes from a fire on the floor next below which has an opening in the ceiling connecting it to the first named floor comprising; an apertured duct extending around said opening having its inlet connected to said duct and its outlet discharging outdoors; means for driving said fan; an intake for providing air to said opening from above; a sprinkler system on said floor below positioned at said opening to form a water curtain therefor; an additional sprinkler system on said floor below for playing water on the fire; and means responsive to the flow of water to either sprinkler system for causing operation of said fan by said driving means; said fan and duct being of sufficient capacity to draw air from said air intake downwardly through the Wellway opening and with fumes from the fire entrained therein into said duct and to exhaust said air and fumes to outdoors.

16. A system for protecting each of a plurality of floors of a multistory building against fumes from a fire on a floor below such floor, each of said plurality of floors having an opening to the floor below, said system comprising; a slotted duct for each opening, each duct extending downwardly around the opening for which it is provided; an exhaust duct common to said first named ducts and connected thereto; an exhaust fan having its inlet connected to said exhaust duct and its outlet discharging outdoors; means for driving said fan; an intake for providing air to said openings from above; means responsive to such fire for causing operation of said fan by said driving means; said fan and duct being of sufficient capacity to draw air from said air intake downwardly through the opening for the floor above the one on which the fire occurs and with fumes from the fire entrained therein into the duct for that opening and to exhaust said air and fumes outdoors; a sprinkler system for each opening positioned to form a water curtain therefor on the outside of the first named duct for that opening; and means operable when the temperature at the opening to the floor above the one on which the fire occurs reaches a certain point for causing operation of said sprinkler system for such opening.

17. A system for protecting each of a plurality of floors of a multistory building against fumes from a fire on a floor below such floor, which building has a plurality of superimposed moving stairways, one extending from each of said plurality of floors to the floor below, each stairway having a wellway opening, said system comprising; a collection duct for each opening, each duct extending downwardly around the opening for which it is provided and having a substantially continuous intake slot in its outer wall; an exhaust duct common to said collection ducts and connected thereto; an exhaust fan having its inlet connected to said exhaust duct and its outlet discharging outdoors; a driving motor for said fan; an intake for providing air to said openings from above; means responsive to the flow of water to for causing operation of said fan by said motor, said fan and ducts being of sufficient capacity to draw air from said air intake downwardly through the wellway opening and with any fumes from the fire entrained therein into the collection duct for that opening and to exhaust it outdoors; a plurality of sprinkler heads for each opening positioned to form when in operation a water curtain therefor around the collection duct; and pilot sprinklers for each opening for causing operation of said water curtain sprinkler heads for that opening when the temperature at such opening reaches a certain point.

18. A fume protection system for a building comprising a means for opening connecting one portion of the building with another portion, said system comprising; a collection duct for said opening; an exhaust fan having its inlet connected to said duct and its outlet discharging outdoors; and a sprinkler system for providing a water deluge covering the entire opening.

19. A system for protecting one portion of a building against fumes from a fire in another portion which has an opening connecting with said first named portion, said system comprising; a collection duct for said opening; an exhaust fan having its inlet connected to said duct and its outlet discharging outdoors for drawing air and entrained fumes into the duct and discharging the air and fumes outdoors; a sprinkler system positioned at said opening to form a water curtain therefor outside said duct; and an additional sprinkler system inside said opening for providing a water deluge throughout the entire opening.

20. A system for protecting a floor of a building against fumes from a fire on the floor next below which has an opening in the ceiling for a stairway connecting said floors, said system comprising; a collection duct extending around said opening; an exhaust fan having its inlet connected to said duct and its outlet discharging outdoors; means for driving said fan; a sprinkler system having heads positioned to provide a water curtain around said opening and collection duct; an additional sprinkler system having sprinkler heads within said opening to provide a water deluge down the stairway; means responsive to temperature around said opening for starting the first named sprinkler system in operation; means responsive to temperature around said opening for starting said additional sprinkler system in operation; and means responsive to the flow of water to either sprinkler system for starting said fan in operation by said driving means.

21. A system for protecting a floor of a building against fumes from a fire on the floor next below which has an opening in the ceiling for a moving stairway extending between said floors, said system comprising; a collection duct extending around said opening; a motor driven exhaust fan having its inlet connected to said duct and its outlet discharging outdoors; a sprinkler system positioned on the ceiling of said floor below having heads disposed at specified points, said heads reacting to a fire in their vicinity to fight the fire; a second sprinkler system having heads positioned to provide a water curtain around said opening and collection duct; a third sprinkler system having sprinkler heads within said opening to provide a water deluge down the stairway; means responsive to temperature around said opening for starting said second named sprinkler system in operation; means responsive to temperature...
within said opening for starting said third sprinkler system in operation; and means responsive to the flow of water to any of said sprinkler systems for starting said fan in operation.

22. A system for protecting a floor of a building against fumes from a fire on the floor next below which has an opening in the ceiling for a moving stairway extending between said floors, said system comprising: a collection duct extending around said opening; a motor driven exhaust fan having its inlet connected to said duct and its outlet discharging outdoors; a normally closed damper in the connection from said duct to said fan; a sprinkler system on the ceiling of said floor below having heads disposed at spaced points, said heads reacting to a fire in their vicinity to fight the fire; a second sprinkler system having heads positioned to provide a water curtain around said opening and collection duct; means responsive to temperature around said opening for starting said second named sprinkler system in operation; and means responsive to the flow of water to either of said sprinkler systems for starting said fan in operation and opening said damper and for stopping said moving stairway.

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