exiting air in order to properly dispel the air or using a tall stack, both of which serve to avoid re-entrainment of the discharged exhaust gas.

[0005] In this regard, reference is made to U.S. Patent No. 6,431,974, issued to Tetley et al., U.S. Patent No. 4,806,076, issued to Andrews, and U.S. Patent No. 5,439,349, issued to Kupferberg, which are designed to provide a high velocity jet for exhausting atmosphere and other gases. These exhaust fans are typically mounted on the roof areas of buildings and are used to carry exhaust gases as high as possible above the roof line of the building so as to ensure an effective final dilution of the gases within the greatest possible volume of ambient air and to ensure their dispersal over a large area with maximum dilution.

[0006] For example, the radial upblast exhaust fan apparatus described and shown in U.S. Patent No. 4,806,076 has a nozzle in which two converging flow paths are defined by two respective passageways. A fan is positioned within the fan housing to urge exhaust gases to flow upwardly through the exhaust paths. A passive zone located between the two flow paths supplies environmental air for mixing by induction into the contaminated gases being exhausted through the converging flow paths.

[0007] These conventional systems exhaust the air away from building intakes or any other areas that could lead to re-entrainment of the discharged exhaust gas and to people inhaling the exhaust. The common range for velocity discharge from a stack is 1,000-3,000 fpm. The ANSI standard for these fans is to maintain 3000 fpm at the discharge of the fan.

[0008] Thus, in view of the foregoing, there is a need for control systems for exhaust gas fan systems that ensure proper system performance and provide efficient and safe operation. Embodiments of the present invention provide such control systems and methods.

SUMMARY

[0009] The following is a simplified summary of the invention in order to provide a basic understanding of some of the aspects of the invention. This summary is not intended to identify key or critical elements of the invention or to define the scope of the invention.

[0010] In accordance with the present invention a control system is provided for exhaust gas systems of the type described above. The control system may be mounted directly on to the fan plenum so that it can operate one or more of: by-pass damper actuators, stage the fans on multiple fan systems, control the fan drive systems, adjust discharge nozzles, determine the static pressure in the exhaust system, and determine the air flow through the fan. The control system may control one or more of the above exhaust system components in order to maintain a

minimum gas exhaust through the exhaust fan while still maintain a minimum discharge velocity to ensure proper operation of the exhaust system. This helps to conserve energy.

[0011] According to one aspect of the invention, the control system maintains the by-pass damper closed when gas flow is above a certain minimum and otherwise opens the by-pass damper to maintain gas exhaust above the minimum. A constant static pressure may be maintained in the exhaust system header by modulating the by-pass damper. By keeping the by-pass damper closed except when it is necessary to open the by-pass damper in order to correctly control airflow, considerable savings in energy may be obtained. In other embodiments, the by-pass damper may be eliminated altogether.

[0012] According to yet another aspect of the invention, the controller controls a plurality of variable speed fans mounted on a common plenum in a multiple fan system. A adjustable speed fan drive (VSD or VFD) may be provided for each of the fans. The fan speed may be adjusted between a pre-set minimum and a pre-set maximum speed for the fans. When multiple fans are energized, the control system preferably balances the load (*e.g.*, flow rate) substantially equally between the fans.

[0013] According to one aspect of the invention, adjustable nozzles may be used to maintain a constant pressure in the exhaust system header. An actuator may be used to change the position of a portion of the outlet nozzle thereby adjusting the nozzle outlet area. Decreasing the nozzle outlet area decreases the flow and increases the velocity of the exhaust air exiting the nozzle. Increasing the nozzle outlet area increases the flow and decreases the velocity of the exhaust air.

[0014] According to another aspect of the invention, the control system is designed to maintain a minimum pre-determined discharge velocity. This minimum point would be determined with the intent to avoid stack downwash and possible re-entrainment conditions.

[0015] According to another aspect of the invention, in cases where the building airflow demand could drop below the level needed to maintain the set velocity, the fan(s) may be mounted on a mixing plenum with by-pass or bleed-in dampers. The control system would modulate these dampers to "make-up" the additional air needed to maintain the set velocity through the exhaust fan.

[0016] According to one embodiment, a single exhaust fan is provided and the control system controls one or more of: by-pass dampers, fan speed, and adjustable outlet nozzles to maintain system set point. The exhaust gas fan system may include and the control system may control any one component, sub-combination of components, or all components listed above.

[0017] According to another embodiment, multiple exhaust fans are provided and the control system controls one or more of: by-pass dampers, fan speed, the number and staging of fans, and adjustable outlet nozzles to maintain system set point. The control system may also control the operation of isolation dampers. When an exhaust fan is de-energized, the isolation damper is closed. When an exhaust fan is energized, the isolation damper is opened. The exhaust gas fan system may include and the control system may control any one component, sub-combination of components, or all components listed above.

[0018] According to another aspect of the invention, at least three fans are mounted on a common plenum. At least one fan is operating and at least one fan is in a standby mode. One of the fans may comprise a redundant fan. In case of failure of one of the fans, the control system may energize a redundant fan for exhaust safety. The controls may provide for cycling and sequencing of the fans.

[0019] Additional features and advantages of the invention will be made apparent from the following detailed description of illustrative embodiments that proceeds with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] The foregoing summary, as well as the following detailed description of preferred embodiments, is better understood when read in conjunction with the appended drawings. For the purpose of illustrating the invention, there is shown in the drawings exemplary constructions of the invention; however, the invention is not limited to the specific methods and instrumentalities disclosed. Included in the drawing are the following Figures:

[0021] FIG. 1 shows an exemplary building exhaust gas fan system;

[0022] FIG. 2A shows an exemplary exhaust gas fan system having a control system in accordance with an embodiment of the invention and having a pressure sensor, by-pass dampers and adjustable speed drives;

[0023] FIG. 2B is flow diagram illustrating the logic of an exemplary control system for controlling the building exhaust gas fan system of FIG. 2A;

[0024] FIGs. 3A and 3B show an exemplary exhaust fan that may be mounted on a roof of a building;

[0025] FIGs. 4A and 4B show an exemplary exhaust fan system having two exhaust fans;

exiting air in order to properly dispel the air or using a tall stack, both of which serve to avoid re-entrainment of the discharged exhaust gas.

[0005] In this regard, reference is made to U.S. Patent No. 6,431,974, issued to Tetley et al., U.S. Patent No. 4,806,076, issued to Andrews, and U.S. Patent No. 5,439,349, issued to Kupferberg, which are designed to provide a high velocity jet for exhausting atmosphere and other gases. These exhaust fans are typically mounted on the roof areas of buildings and are used to carry exhaust gases as high as possible above the roof line of the building so as to ensure an effective final dilution of the gases within the greatest possible volume of ambient air and to ensure their dispersal over a large area with maximum dilution.

[0006] For example, the radial upblast exhaust fan apparatus described and shown in U.S. Patent No. 4,806,076 has a nozzle in which two converging flow paths are defined by two respective passageways. A fan is positioned within the fan housing to urge exhaust gases to flow upwardly through the exhaust paths. A passive zone located between the two flow paths supplies environmental air for mixing by induction into the contaminated gases being exhausted through the converging flow paths.

[0007] These conventional systems exhaust the air away from building intakes or any other areas that could lead to re-entrainment of the discharged exhaust gas and to people inhaling the exhaust. The common range for velocity discharge from a stack is 1,000-3,000 fpm. The ANSI standard for these fans is to maintain 3000 fpm at the discharge of the fan.

[0008] Thus, in view of the foregoing, there is a need for control systems for exhaust gas fan systems that ensure proper system performance and provide efficient and safe operation. Embodiments of the present invention provide such control systems and methods.

OBJECT

[0008A] It is the object of the present invention to substantially overcome or ameliorate one or more of the disadvantages of the prior art, or at least provide a useful alternative.

SUMMARY

[0008B] A first aspect of the present invention provides a control system configured to exhaust gas from a building of the type including ducting, a plenum in fluid communication with the ducting, an exhaust fan on the plenum, the exhaust fan configured to draw gas through the plenum so as to discharge the gas through an outlet, and a variable speed fan drive that operates the exhaust fan at variable speeds, the control system comprising: a first static pressure probe disposed in the ducting and a second static pressure probe disposed in the plenum, the first and

second static pressure probes operable to measure a static pressure of the exhaust gas, wherein the control system receives inputs from the static pressure probes and controls the speed of the exhaust fan so as to maintain a discharge velocity of gas at the outlet.

[0008C] A second aspect of the present invention provides a building exhaust system configured to control exhaust gas flow from a building, the exhaust system comprising: ductwork configured to carry the exhaust gas; a plenum configured to receive the exhaust gas from the ductwork; at least one fan on the plenum, the at least one fan coupled to a variable speed fan drive, the at least one fan configured to blow the exhaust gas out the building through an outlet; and a control system including: a first static pressure probe disposed in the ductwork; a second static pressure probe disposed in the plenum, the first and second static pressure probes operable to measure the static pressure of the exhaust gas, wherein the control system receives inputs from the static pressure probes and controls the variable speed fan drive so as to maintain a discharge velocity of gas at the outlet.

[0008D] A third aspect of the present invention provides a method of controlling a flow of exhaust gas from a building of the type having ducting, a plenum in fluid communication with the ducting, and at least one fan on the plenum, the at least one fan configured to force the exhaust gas through the ducting and the plenum, and out the building, the method comprising the steps of: sensing a static pressure of the exhaust gas both in the ductwork and in the plenum; determining whether the sensed static pressure corresponds to an actual exhaust gas flow rate that is above or below a minimum exhaust gas flow rate; controlling the at least one fan to maintain the actual exhaust gas flow rate at or above the minimum exhaust gas flow rate.

[0008E] A fourth aspect of the present invention provides a control system configured to exhaust gas from a building of the type including ducting, a plenum in fluid communication with the ducting, an exhaust fan on the plenum, the exhaust fan configured to draw gas through the plenum so as to discharge the gas through an outlet nozzle having an adjustable flow-through area, and a variable speed fan drive that operates the exhaust fan at variable speeds; the control system comprising: a static pressure probe disposed in at least one of the plenum or the ducting, the static pressure probe operable to measure a static pressure of the exhaust gas; and a flow transducer, operable to determine flow rate through the ducting; wherein the control system adjusts the flow-through area so as to maintain constant pressure in the ducting and to maintain a discharge velocity of gas at the outlet.

[0009] The following is a simplified summary of the invention in order to provide a basic understanding of some of the aspects of the invention. This summary is not intended to identify key or critical elements of the invention or to define the scope of the invention.

[0010] In accordance with at least a preferred embodiment of the present invention a control system is provided for exhaust gas systems of the type described above. The control system may be mounted directly on to the fan plenum so that it can operate one or more of: by-pass damper actuators, stage the fans on multiple fan systems, control the fan drive systems, adjust discharge nozzles, determine the static pressure in the exhaust system, and determine the air flow through the fan. The control system may control one or more of the above exhaust system components in order to maintain a minimum gas exhaust through the exhaust fan while still maintain a minimum discharge velocity to ensure proper operation of the exhaust system. This helps to conserve energy.

[0011] According to one embodiment of the invention, the control system maintains the by-pass damper closed when gas flow is above a certain minimum and otherwise opens the by-pass damper to maintain gas exhaust above the minimum. A constant static pressure may be maintained in the exhaust system header by modulating the by-pass damper. By keeping the by-pass damper closed except when it is necessary to open the by-pass damper in order to correctly control airflow, considerable savings in energy may be obtained. In other embodiments, the by-pass damper may be eliminated altogether.

[0012] According to yet another embodiment of the invention, the controller controls a plurality of variable speed fans mounted on a common plenum in a multiple fan system. A adjustable speed fan drive (VSD or VFD) may be provided for each of the fans. The fan speed may be adjusted between a pre-set minimum and a pre-set maximum speed for the fans. When multiple fans are energized, the control system preferably balances the load (*e.g.*, flow rate) substantially equally between the fans.

[0013] According to one embodiment of the invention, adjustable nozzles may be used to maintain a constant pressure in the exhaust system header. An actuator may be used to change the position of a portion of the outlet nozzle thereby adjusting the nozzle outlet area. Decreasing the nozzle outlet area decreases the flow and increases the velocity of the exhaust air exiting the nozzle. Increasing the nozzle outlet area increases the flow and decreases the velocity of the exhaust air.

[0014] According to another embodiment of the invention, the control system is designed to maintain a minimum pre-determined discharge velocity. This minimum point would be determined with the intent to avoid stack downwash and possible re-entrainment conditions.

[0015] According to another embodiment of the invention, in cases where the building airflow demand could drop below the level needed to maintain the set velocity, the fan(s) may be mounted on a mixing plenum with by-pass or bleed-in dampers. The control system would modulate these dampers to "make-up" the additional air needed to maintain the set velocity through the exhaust fan.

[0016] According to one embodiment, a single exhaust fan is provided and the control system controls one or more of: by-pass dampers, fan speed, and adjustable outlet nozzles to maintain system set point. The exhaust gas fan system may include and the control system may control any one component, sub-combination of components, or all components listed above.

[0017] According to another embodiment, multiple exhaust fans are provided and the control system controls one or more of: by-pass dampers, fan speed, the number and staging of fans, and adjustable outlet nozzles to maintain system set point. The control system may also control the operation of isolation dampers. When an exhaust fan is de-energized, the isolation damper is closed. When an exhaust fan is energized, the isolation damper is opened. The exhaust gas fan system may include and the control system may control any one component, sub-combination of components, or all components listed above.

[0018] According to another embodiment of the invention, at least three fans are mounted on a common plenum. At least one fan is operating and at least one fan is in a standby mode. One of the fans may comprise a redundant fan. In case of failure of one of the fans, the control system may energize a redundant fan for exhaust safety. The controls may provide for cycling and sequencing of the fans.

[0019] Additional features of the invention will be made apparent from the following detailed description of illustrative embodiments that proceeds with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] The foregoing summary, as well as the following detailed description of preferred embodiments, is better understood when read in conjunction with the appended drawings. For the purpose of illustrating the invention, there is shown in the drawings exemplary

constructions of the invention; however, the invention is not limited to the specific methods and instrumentalities disclosed. Included in the drawing are the following Figures:

[0021] FIG. 1 shows an exemplary building exhaust gas fan system;

[0022] FIG. 2A shows an exemplary exhaust gas fan system having a control system in accordance with an embodiment of the invention and having a pressure sensor, by-pass dampers and adjustable speed drives;

[0023] FIG. 2B is flow diagram illustrating the logic of an exemplary control system for controlling the building exhaust gas fan system of FIG. 2A;

[0024] FIGs. 3A and 3B show an exemplary exhaust fan that may be mounted on a roof of a building;

[0025] FIGs. 4A and 4B show an exemplary exhaust fan system having two exhaust fans;

Claims:

1. A control system configured to exhaust gas from a building of the type including ducting, a plenum in fluid communication with the ducting, an exhaust fan configured to draw gas through the plenum so as to discharge the gas through an outlet, and a variable speed fan drive that operates the exhaust fan at variable speeds, the control system comprising:

a first static pressure probe disposed in the ducting and a second static pressure probe disposed in the plenum, the first and second static pressure probes operable to measure a static pressure of the exhaust gas, wherein the control system receives inputs from the static pressure probes and controls the speed of the exhaust fan so as to maintain a discharge velocity of gas at the outlet.

2. The control system recited in claim 1, further comprising a plurality of variable speed fans configured to draw the exhaust air from the plenum, and a corresponding plurality of variable speed fan drives associated with the variable speed fans, respectively, such that the control system controls the variable speed fan drives.

3. The control system recited in claim 2 wherein at least three fans are on a common the plenum, and wherein at least one fan is operating and the control system maintains one fan in a standby mode.

4. The control system recited in claim 2, wherein when one of the plurality of variable speed fans approaches and/or is at a maximum speed, the control system is configured to energize a second variable speed fan of the plurality of variable speed fans.

5. The control system recited in claim 1, further comprising a bypass damper disposed in the plenum and configured to entrain ambient air into the plenum, wherein the control system closes the bypass damper when the exhaust gas flow is above the minimum exhaust gas flow, and opens said bypass damper to maintain exhaust gas above said minimum.

6. The control system recited in claim 1, wherein the control system increases the speed of the fan to increase the discharge velocity.

7. The control system recited in claim 5, wherein a constant static pressure is maintained within the ducting by modulating said bypass damper.

8. The control system recited in claim 1, wherein the control system receives inputs from the static pressure probes and controls the speed of the exhaust fan so as to maintain a minimum discharge velocity of gas at the outlet.

9. The control system recited in claim 8, wherein the minimum discharge velocity is a minimum pre-determined discharge velocity.

10. The control system recited in claim 1, wherein the control system controls the speed of the exhaust fan so as to maintain a static pressure in the ducting.

11. The control system recited in any one of claims 1, 2, and 4, wherein the outlet comprises an adjustable outlet nozzle having an adjustable flow-through area.

12. The control system recited in claim 11, wherein decreasing the flow-through area decreases the flow of the gas and increases a velocity of the gas exiting the adjustable outlet nozzle, and increasing the flow-through area increases the flow of the gas and decreases the velocity of the gas exiting the adjustable outlet nozzle.

13. The control system recited in claim 12, wherein the control system further sends a signal to the adjustable nozzle so as to control the flow-through area and maintain the discharge velocity of gas at the outlet.

14. The control system recited in claim 13, wherein at start-up, the fan is energized and the speed of the fan is set to a minimum, and the flow-through area is set to a minimum.

15. The control system recited in claim 14, wherein increasing system demand causes the control system to increase the flow-through area.

16. The control system recited in claim 15, wherein when the flow-through area is at a maximum, the control system causes the speed of the fan to increase.

17. The control system recited in claim 1 further comprising:

a plurality of spaced apart wind band sections, each wind band section having a top end defining a top opening, a bottom end defining a bottom opening, and one of more side walls disposed between and connecting said top end to said bottom end;

said plurality of wind band sections being disposed circumferentially and in vertical spaced relation over said outlet and extending generally upward therefrom;

wherein each wind band section has a smallest diameter or width greater than a diameter or width of said outlet.

18. A building exhaust system configured to control exhaust gas flow from a building, the exhaust system comprising:

ductwork configured to carry the exhaust gas;

a plenum configured to receive the exhaust gas from the ductwork;

at least one fan coupled to a variable speed fan drive, the at least one fan configured to blow the exhaust gas out the building through an outlet; and

a control system including:

a first static pressure probe disposed in the ductwork;

a second static pressure probe disposed in the plenum, the first and second static pressure probes operable to measure the static pressure of the exhaust gas, wherein the control system receives inputs from the static pressure probes and controls the variable speed fan drive so as to maintain a discharge velocity of gas at the outlet.

19. The building exhaust system as recited in claim 18, further comprising a plurality of fans, each fan coupled to a variable speed fan drive, respectively, wherein the control system is configured to adjust the fan speed of each fan independently.

20. The building exhaust system recited in claim 19, wherein when one of the plurality of fans approaches and/or is at a maximum speed, the control system is configured to energize a second fan of the plurality of fans.

21. The building exhaust system recited in any one of claims 18, 19, or 20 wherein the outlet comprises an adjustable outlet nozzle having an adjustable flow-through area.

22. The building exhaust system recited in claim 21, wherein decreasing the flow-through area decreases the flow of the gas and increases a velocity of the gas exiting the adjustable outlet nozzle, and increasing the flow-through area increases the flow of the gas and decreases the velocity of the gas exiting the adjustable outlet nozzle.

23. The building exhaust system recited in claim 22, wherein the control system further sends a signal to the adjustable nozzle so as to control the flow -through area and maintain the discharge velocity of gas at the outlet.

24. The building exhaust system recited in claim 23, wherein at start-up, the at least one fan is energized and the speed of the fan is set to a minimum, and the flow-through area is set to a minimum.

25. The building exhaust system recited in claim 24, wherein increasing system demand causes the control system to increase the flow-through area.

26. The building exhaust system recited in claim 25, wherein when the flow-through area is at a maximum, the control system causes the speed of the fan to increase.

27. A method of controlling a flow of exhaust gas from a building of the type having ducting, plenum in fluid communication with the ducting, and at least one fan configured to force the exhaust gas through the ducting and the plenum, and out the building, the method comprising the steps of:

sensing a static pressure of the exhaust gas both in the ductwork and in the plenum;

determining whether the sensed static pressure corresponds to an actual exhaust gas flow rate that is above or below a minimum exhaust gas flow rate;

controlling the at least one fan to maintain the actual exhaust gas flow rate at or above the minimum exhaust gas flow rate.

28. The method as recited in claim 27, wherein the at least one fan is coupled to a variable speed drive configured to operate the at least one fan at variable speeds, the controlling step further comprising varying the fan speed so as to maintain the actual exhaust gas flow rate at or above the minimum exhaust gas flow rate.

29. The method as recited in claim 27, wherein the outlet comprises an adjustable outlet nozzle having an adjustable flow-through area, the method further comprising the steps of decreasing the flow-through area so as to decrease the flow of the gas and increase a velocity of the gas exiting the adjustable outlet nozzle, and increasing the flow-through area so as to increase the flow of the gas and decrease the velocity of the gas exiting the adjustable outlet nozzle.

30. The method as recited in claim 29, wherein the steps of decreasing and increasing the flow-through area further comprise sending a signal to the adjustable nozzle so as to control the flow-through area and maintain the discharge velocity of gas at the outlet.

31. The method as recited in claim 30 wherein at start-up, the controlling step includes energizing at least one of the at least one fan to operate at a minimum speed and setting the flow-through area to a minimum flow-through area.

32. The method as recited in claim 31 wherein, with increasing system the controlling step further includes increasing the flow-through area.

33. The method as recited in claim 32 wherein, when the flow-through area is at a maximum, the controlling step further includes increasing the speed at least one of the at least one fan.

34. The method as recited in claim 27 herein, when the at least one fan is at a minimum speed, opening a bypass damper to maintain the discharge velocity of gas at the outlet.

35. The method as recited in claim 29, wherein, when the flow-through area is at a minimum, opening a bypass damper to maintain the discharge velocity of gas at the outlet.

36. A control system configured to exhaust gas from a building of the type including ducting, a plenum in fluid communication with the ducting, an exhaust fan configured to draw gas through the plenum so as to discharge the gas through an outlet nozzle having an adjustable flow-through area, and a variable speed fan drive that operates the exhaust fan at variable speeds; the control system comprising:

a static pressure probe disposed in at least one of the plenum or the ducting, the static pressure probe operable to measure a static pressure of the exhaust gas; and

a flow transducer, operable to determine flow rate through the ducting;

wherein the control system adjusts the flow-through area so as to maintain constant pressure in the ducting and to maintain a discharge velocity of gas at the outlet.

37. The control system of claim 36, wherein the static pressure probe is disposed in the ducting.

38. The control system of claim 36, further comprising a plurality of variable speed fans, each fan coupled to a variable speed fan drive, respectively, and configured to blow the exhaust gas out the building, wherein the control system is configured to adjust the fan speed of each fan independently.

39. The control system of claim 38, wherein when one of the plurality of fans approaches and/or is at a maximum speed, the control system is configured to energize a second fan of the plurality of fans.

40. The control system of claim 36, wherein decreasing the outlet nozzle flow-through area decreases the flow of the gas and increases a velocity of the gas exiting the adjustable outlet nozzle, and increasing the outlet nozzle flow-through area increases the flow of the gas and decreases the velocity of the gas exiting the adjustable outlet nozzle.

CLAIMS

1. A control system configured to exhaust gas from a building of the type including ducting, a plenum in fluid communication with the ducting, an exhaust fan on the plenum, the exhaust fan configured to draw gas through the plenum so as to discharge the gas through an outlet, and a variable speed fan drive that operates the exhaust fan at variable speeds, the control system comprising:

a first static pressure probe disposed in the ducting and a second static pressure probe disposed in the plenum, the first and second static pressure probes operable to measure a static pressure of the exhaust gas, wherein the control system receives inputs from the static pressure probes and controls the speed of the exhaust fan so as to maintain a discharge velocity of gas at the outlet.

2. The control system recited in claim 1, further comprising a plurality of variable speed fans configured to draw the exhaust air from the plenum, and a corresponding plurality of variable speed fan drives associated with the variable speed fans, respectively, such that the control system controls the variable speed fan drives.

3. The control system recited in claim 2, wherein at least three fans are on the plenum, and wherein at least one fan is operating and the control system maintains one fan in a standby mode.

4. The control system recited in claim 1, further comprising a bypass damper disposed in the plenum and configured to entrain ambient air into the plenum, wherein the control system closes the bypass damper when the exhaust gas flow is above the minimum exhaust gas flow, and opens said bypass damper to maintain exhaust gas above said minimum.

5. The control system recited in claim 1, wherein the control system increases the speed of the fan to increase the discharge velocity.

6. The control system recited in claim 4, wherein a constant static pressure is maintained within the ducting by modulating said bypass damper.

7. The control system recited in claim 1 further comprising:

a plurality of spaced apart wind band sections, each wind band section having a top end defining a top opening, a bottom end defining a bottom opening, and one of more side walls disposed between and connecting said top end to said bottom end;

said plurality of wind band sections being disposed circumferentially and in vertical spaced relation over said outlet and extending generally upward therefrom;

wherein each wind band section has a smallest diameter or width greater than a diameter or width of said outlet.

8. A building exhaust system configured to control exhaust gas flow from a building, the exhaust system comprising:

ductwork configured to carry the exhaust gas;

a plenum configured to receive the exhaust gas from the ductwork;

at least one fan on the plenum, the at least one fan coupled to a variable speed fan drive, the at least one fan configured to blow the exhaust gas out the building through an outlet; and

a control system including:

a first static pressure probe disposed in the ductwork;

a second static pressure probe disposed in the plenum, the first and second static pressure probes operable to measure the static pressure of the exhaust gas, wherein the control system receives inputs from the static pressure probes and controls the variable speed fan drive so as to maintain a discharge velocity of gas at the outlet.

9. The building exhaust system as recited in claim 8, further comprising a plurality of fans, each fan coupled to a variable speed fan drive, respectively, wherein the control system is configured to adjust the fan speed of each fan independently.

10. A method of controlling a flow of exhaust gas from a building of the type having ducting, a plenum in fluid communication with the ducting, and at least one fan on the plenum, the at least one fan configured to force the exhaust gas through the ducting and the plenum, and out the building, the method comprising the steps of:

sensing a static pressure of the exhaust gas both in the ductwork and in the plenum;

determining whether the sensed static pressure corresponds to an actual exhaust gas flow rate that is above or below a minimum exhaust gas flow rate;

controlling the at least one fan to maintain the actual exhaust gas flow rate at or above the minimum exhaust gas flow rate.

11. The method as recited in claim 10, wherein the at least one fan is coupled to a variable speed drive configured to operate the at least one fan at variable speeds, the controlling step further comprising varying the fan speed so as to maintain the actual exhaust gas flow rate at or above the minimum exhaust gas flow rate.

12. The control system recited in claim 9, wherein when one of the plurality of variable speed fans approaches and/or is at a maximum speed, the control system is configured to energize a second variable speed fan of the plurality of variable speed fans.

13. The control system recited in claim 8, wherein the control system receives inputs from the static pressure probes and controls the speed of the exhaust fan so as to maintain a minimum discharge velocity of gas at the outlet.

14. The control system recited in claim 13, wherein the minimum discharge velocity is a minimum per-determined discharge velocity.

15. The control system recited in claim 8, wherein the control system controls the speed of the exhaust fan so as to maintain a static pressure in the ducting.

16. The control system recited in claim 8, wherein the outlet comprises an adjustable outlet nozzle having an adjustable flow-through area.

17. The control system recited in claim 16, wherein decreasing the flow-through area decreases the flow of the gas and increases a velocity of the gas exiting the adjustable outlet nozzle, and increasing the flow-through area increases the flow of the gas and decreases the velocity of the gas exiting the adjustable outlet nozzle.

18. The control system recited in claim 17, wherein the control system further sends a signal to the adjustable nozzle so as to control the flow-through area and maintain the discharge velocity of gas at the outlet.

19. The control system recited in claim 18, wherein at start-up, the fan is energized and the speed of the fan is set to a minimum, and the flow-through area is set to a minimum.

20. The control system recited in claim 19, wherein increasing system demand causes the control system to increase the flow-through area.

21. The control system recited in claim 20, wherein when the flow-through area is at a maximum, the control system causes the speed of the fan to increase.

22. The building exhaust system recited in claim 9, wherein when one of the plurality of fans approaches and/or is at a maximum speed, the control system is configured to energize a second fan of the plurality of fans.

23. The building exhaust system recited in claim 8, wherein the outlet comprises an adjustable outlet nozzle having an adjustable flow-through area.

24. The building exhaust system recited in claim 23, wherein decreasing the flow-through area decreases the flow of the gas and increases a velocity of the gas exiting the adjustable outlet nozzle, and increasing the flow-through area increases the flow of the gas and decreases the velocity of the gas exiting the adjustable outlet nozzle.

25. The building exhaust system recited in claim 24, wherein the control system further sends a signal to the adjustable nozzle so as to control the flow -through area and maintain the discharge velocity of gas at the outlet.

26. The building exhaust system recited in claim 25, wherein at start-up, the at least one fan is energized and the speed of the fan is set to a minimum, and the flow-through area is set to a minimum.

27. The building exhaust system recited in claim 26, wherein increasing system demand causes the control system to increase the flow-through area.

28. The building exhaust system recited in claim 27, wherein when the flow-through area is at a maximum, the control system causes the speed of the fan to increase.

29. The method as recited in claim 10, wherein the outlet comprises an adjustable outlet nozzle having an adjustable flow-through area, the method further comprising the steps of decreasing the flow-through area so as to decrease the flow of the gas and increase a velocity of the gas exiting the adjustable outlet nozzle, and increasing the flow-through area so as to increase the flow of the gas and decrease the velocity of the gas exiting the adjustable outlet nozzle.

30. The method as recited in claim 29, wherein the steps of decreasing and increasing the flow-through area further comprise sending a signal to the adjustable nozzle so as to control the flow-through area and maintain the discharge velocity of gas at the outlet.

31. The method as recited in claim 30, wherein at start-up, the controlling step includes energizing at least one of the at least one fan to operate at a minimum speed and setting the flow-through area to a minimum flow-through area.

32. The method as recited in claim 31, wherein, with increasing system the controlling step further includes increasing the flow-through area.

33. The method as recited in claim 32, wherein, when the flow-through area is at a maximum, the controlling step further includes increasing the speed at least one of the at least one fan.

34. The method as recited in claim 10, wherein, when the at least one fan is at a minimum speed, opening a bypass damper to maintain the discharge velocity of gas at the outlet.

35. The method as recited in claim 29, wherein, when the flow-through area is at a minimum, opening a bypass damper to maintain the discharge velocity of gas at the outlet.

36. A control system configured to exhaust gas from a building of the type including ducting, a plenum in fluid communication with the ducting, an exhaust fan on the plenum, the exhaust fan configured to draw gas through the plenum so as to discharge the gas through an outlet nozzle having an adjustable flow-through area, and a variable speed fan drive that operates the exhaust fan at variable speeds; the control system comprising:

a static pressure probe disposed in at least one of the plenum or the ducting, the static pressure probe operable to measure a static pressure of the exhaust gas; and

a flow transducer, operable to determine flow rate through the ducting;

wherein the control system adjusts the flow-through area so as to maintain constant pressure in the ducting and to maintain a discharge velocity of gas at the outlet.

37. The control system of claim 36, wherein the static pressure probe is disposed in the ducting.

38. The control system of claim 36, further comprising a plurality of variable speed fans, each fan coupled to a variable speed fan drive, respectively, and configured to blow the exhaust gas out the building, wherein the control system is configured to adjust the fan speed of each fan independently.

39. The control system of claim 36, wherein when one of the plurality of fans approaches and/or is at a maximum speed, the control system is configured to energize a second fan of the plurality of fans.

40. The control system of claim 36, wherein decreasing the outlet nozzle flow-through area decreases the flow of the gas and increases a velocity of the gas exiting the adjustable outlet nozzle, and increasing the outlet nozzle flow-through area increases the flow of the gas and decreases the velocity of the gas exiting the adjustable outlet nozzle.

41. A control system configured to exhaust gas from a building substantially as hereinbefore described with reference to any one of the embodiments as that embodiment is shown in the accompanying drawings.

42. A building exhaust system configured to control exhaust gas flow from a building substantially as hereinbefore described with reference to any one of the embodiments as that embodiment is shown in the accompanying drawings.

43. A method of controlling a flow of exhaust gas from a building substantially as hereinbefore described with reference to any one of the embodiments as that embodiment is shown in the accompanying drawings.