AIR VENT INSERTS

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Appl. No.: 11/112,582
Filed: Apr. 22, 2005

Publication Classification

Int. Cl. F24F 13/06 (2006.01)
U.S. Cl. ................................................ 454/329

ABSTRACT

An air vent insert for boosting circulation and/or purifying the air in the room in a safe and cost effective manner is disclosed. The insert includes a housing configured to be inserted into an air duct and covered by a face plate. The housing has a flange portion that rests on the wall or floor surrounding the duct opening and a body portion recessed in the duct to achieve a low profile design. The body portion contains one or more fans and/or air purification units coupled to an electronic control unit. For increased safety, the entire unit operates on low voltage DC power supplied from an AC/DC converter plugged into a standard 3 prong wall outlet.
Fig. 2
AIR VENT INSERTS

TECHNICAL FIELD

[0001] The present invention is generally related to air movers and air purifiers, and more particularly, but not exclusively, is related to indoor air movers and purifiers that can be unobtrusively mounted in an air duct opening. For example, certain embodiments of the present invention can be considered improvements to the device depicted in U.S. Pat. No. 5,632,677.

BACKGROUND

[0002] Indoor air quality is a matter of growing concern, and a variety of air movers and/or air purification devices have been developed. For example, air purification units, including static electricity filters, ozone generators, UV generators, and negative ion generators, clean and sanitize the air by collecting dust, killing airborne molds and bacteria, or otherwise reducing the level of airborne pollutants. Fans and blowers can be used alone or in combination with these air purification units to circulate air in a single room or to move air through a HVAC system. However, while the basic operation of these types of devices is well known, there is still room for improvement, particularly with respect to ease of installation, ease of integration with other devices or into a whole house system, energy efficiency, safety, and cost effectiveness.

[0003] For example, many commercially available stand alone units are bulky, inefficient and not easily and/or unobtrusively integrated into a room. These units traditionally run on AC power, and existing furniture, traffic patterns and aesthetic constraints often dictate where these stand alone units may be located in a room. Other types of units are designed to be substantially permanently mounted inside the ductwork or directly to a central furnace or air conditioner. While such mounting avoids the concerns with being located in the living space, retrofitting these devices into existing systems can be a challenge, since modifications to the existing ductwork and electrical wiring are often required. Furthermore for both stand alone units and permanently installed devices, finding the proper settings and making appropriate adjustments for changing conditions can be a challenge. Accordingly, there is a need for improved air movers and purification devices that are easy to install and/or which can be easily retrofit into existing HVAC systems. The present invention addresses these needs and does so in an efficient and cost effective manner.

BRIEF DESCRIPTION OF THE FIGURES

[0004] Although the characteristic features of this invention will be particularly pointed out in the claims, the invention itself, and the manner in which it may be made and used, may be better understood by referring to the following description taken in connection with the accompanying figures forming a part thereof.

[0005] FIG. 1 is an exploded view of a vent fan according to a first embodiment.

[0006] FIG. 2 is a perspective view of the FIG. 1 vent fan.

[0007] FIG. 3 is a side sectional view of a vent fan with integrated air purifier as installed in an air vent opening.

[0008] FIG. 4 is a perspective view of the FIG. 1 vent fan replacing a floor vent in a room and in wireless communication with a wall mounted thermostat.

[0009] FIG. 5 is a cutaway view of the underside of a UV air purifier according to another embodiment.

SUMMARY

[0010] In one form, the present invention provides an air vent insert for boosting circulation and/or purifying the air in the room in a safe and cost effective manner. The insert includes a housing configured to be inserted into an air duct and covered by a face plate. The housing has a flange portion that rests on the wall or floor surrounding the duct opening and a body portion recessed in the duct to achieve a low profile design. The body portion contains one or more fans and/or air purification units coupled to an electronic control unit. For increased safety, the entire unit operates on low voltage DC power supplied from an AC/DC converter plugged into a standard 3 prong wall outlet.

DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

[0011] For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the embodiments illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is hereby intended. Alterations and further modifications in the illustrated devices, and such further applications of the principles of the invention as illustrated herein are contemplated as would normally occur to one skilled in the art to which the invention relates.

[0012] In one form, the present invention provides a vent fan for placement in an air duct. Referring to FIGS. 1 and 2, a vent fan according to an embodiment includes a pair of fans 17 and 18 mounted in a housing 12. Housing 12 has a body portion 14 and a flange portion 16. Body portion 14 is sized to fit into an air duct, and as illustrated is generally rectangular in shape so as to fit into a standard rectangular air duct opening. Flange portion 16 extends around the periphery of the top of the body portion 14 to create a lip that can rest on the wall or floor surrounding the air duct opening while body portion 14 extends into the duct.

[0013] An electronic control unit 30 is mounted in housing 12 between fans 17, 18 and serves to control the operation of the fans. A face plate 20 mounts to the housing and has a pair of grills 21, 22 that cover fans 17 and 18 respectively. A control panel 23 is located between grills 21, 22 and includes a series of buttons 24 that are aligned with corresponding contact pads 34 on control unit 30. Indicator lights 32 are provided on control unit 30 and are configured to shine through corresponding windows 26 in control panel 23.

[0014] In the illustrated embodiment, air vent 10 is configured for safe, low voltage operation. The electrical power for vent 10 is preferably in the form of a direct current (DC). The DC power is supplied via an AC/DC converter 95 (FIG. 4) that plugs into a standard 3 prong electrical outlet and converts AC power from the wall outlet into 12V DC power to vent 10. The male end of the adapter cord 29 connects to power socket 36 on control unit 30 through an opening in
face plate 20, and a channel 28 is provided in face plate 20 to accommodate the power cord. As shown in FIG. 2, this allows the power cord to be substantially flush with the top face of face plate 20 and out of the way when vent 10 is in use.

[0015] The use of low voltage DC power is advantageous for a variety of reasons. Low voltage and low current operation consumes less power and is more energy efficient than AC operation. Less costly components can be used, and the lower risk of electrical shock qualifies the device for a less rigorous UL certification procedure. The increased safety from low voltage operation is particularly important for floor mounted units such as shown in FIG. 4, and/or where small children or pets are around, since it reduces the risks of serious accidents or injuries due to spilled liquids or foreign objects falling into the device.

[0016] In other embodiments, other sources of power may be employed, such as 24V A/C or 115V A/C. In one contemplated embodiment, device 10 is modified to operate on battery power, for example rechargeable batteries. In still other embodiments, device 10 may be hardwired to operate electrical systems. For example, in one embodiment, the device 10 is wired to and receives power (e.g. 24V A/C) directly from the central furnace or air conditioner or other central HVAC component.

[0017] Vent fan 10 can be assembled from existing components and low cost materials. Housing 12 is preferable designed as unitary plastic, for example constructed via a die cast or molding process. Appropriate projections and retaining clips can be integrally formed with the housing to allow fans 17, 18 and control unit 30 to be snap fit in place. Control unit 30 can be constructed from printed circuit board with appropriate electronic components, such as a microprocessor and associated memory, for carrying out the control functions described more fully below. Fans 17, 18 can be single speed or multiple speeds. Preferably, the fans are variable speed fans or are continuously variable with the fan speed set by controller 30. To promote quite operation and reduce wear on the fans, the controller can be configured to gradually ramp up fans speed and/or provide power in a cycle or hysteresis.

[0018] It is to be appreciated that in use, vent fan 10 would be mounted in an air duct as a replacement to existing face plates. With the fans blowing into the room, vent fan 10 serves to boost the flow of conditioned air from the central furnace or air conditioner (not shown) into the room. Control unit 30 is preferably programmed to have different operation modes, and the fan speed is programmable or selectable based on the size of the room. Optionally, one or more temperature sensors are connected to control unit 30 to sense the temperature of the air in the air duct and/or in the room, and control unit 30 controls operation of the fans based on signals from these temperature sensors(s). Suitable temperature sensors include thermistors, thermocouples or bi-metal strips. A user can select the desired operational mode via buttons 24, and the power status and operational mode can be indicated via lights 32.

[0019] Alternatively or in addition, device 10 can be adapted to receive control signals remotely. In this variation, a wireless receiver, such as one that receives IR, RF or blue tooth signals, is connected to control unit 30. Where line of sight is important (such as with IR transmitters) a receiver can be located on face plate 20 and hardwired to control unit 30. In this way, device 10 can receive control signals or other inputs from a handheld device, a wall mounted remote control and/or a central furnace or air conditioner without the need to run additional wires.

[0020] For example, FIG. 4 illustrates one such implementation where wireless electromagnetic signals 98, 99 are used to establish communication between a floor mounted air vent and a wall mounted thermostat 97. A transmitter (not shown) in the thermostat 97 sends information such as the measured temperature, a setpoint, and/or the operational status of the furnace or air conditioner to the receiver (not shown) in the vent fan 10. Control unit 30 would then process this information, for example comparing the temperature measured at the vent with the temperature received from the thermostat, and take appropriate corrective action, such as by activating fans 17, 18. In still another variation, a motion sensor can be used, for example to power on the device or change it operational mode when someone enters the room. The motion sensor can be mounted on the face plate 20 or it may be freestanding and connected wirelessly to the control unit.

[0021] Embodiment are also contemplated where the face plate 20 is devoid of all controls. Such a device can rely solely on remote control (such as RF) or the appropriate control buttons can be concealed under the face plate 20, for example under flange portion 16 or along the side of body portion 14 of housing 12.

[0022] Useful operational modes of devices according to the present invention include a heating mode, a cooling mode, a continuous operation mode, and a timed mode. In an exemplary heating mode, control unit 30 monitors the temperature in the room and in the air duct. When control unit 30 senses that the temperature in the duct has increased relative to the temperature in the room (a condition that would indicate that the furnace has begun to blow heat through the ducts) control unit 30 starts fans 17, 18. The fans then run continuously until control unit 30 determines that the temperature in the duct has begun to decrease (indicating that the furnace has ended its run) at which time control unit 30 shuts off the fans and waits for the next cycle. Cooling mode operation would be similar to heating mode save that fans 17, 18 are operated when the temperature in the duct is determined to be lower than the temperature in the room. The fans can be configured to operate substantially continuously in continuous operation mode and for a set time period in the timed mode.

[0023] In addition to or in place of functioning as an air booster, vent fan 10 can be modified to incorporate one or more air purification devices. Referring now to FIG. 3, a vent device 80 is depicted mounted in a floor duct 40. Like vent fan 10 described above, flange portion 16 rests on the floor 50 surrounding the duct opening, and face plate 20 covers the device. With body portion 14 recessed below floor 50, vent device 80 also has a low profile, for example, having the distance D between the upper surface of face plate 20 and the plane of the surrounding floor 50 be less than about 1.5 inches.

[0024] Vent device 80 includes a temperature sensor 70 and is otherwise identical to vent device 10 save the addition of an air purification system 90. Any of a variety of commercially available air purification systems can be
employed in this manner, such as those employing ozone generators, UV filters, negative ion generators, static electricity filters, photocatalytic oxidation or combinations thereof. An exemplary ozone based system is illustrated in FIG. 3 and includes a pair of plate emitters 64 and 68 electrically connected via lines 66, 62 to a high voltage generator 60. As is known in the art, ozone is generated in emitters 64, 68 via a high voltage applied across spaced electrodes or conductive plates. A variety of suitable plate-type ozone generators are commercially available, such as Part No. YEK-100 from YEK, HighTech Co. Ltd., Hong Kong. Pipeline-type ozone generators can also be employed, such as Part No. YEK-G20, also from YEK. As illustrated in FIG. 3, purification system 90 is mounted to the underside of housing 14. In an alternative arrangement, housing 14 can be adapted to contain some or all of purification system 90, e.g., so that one or more components of system 90 are mounted inside housing 14.

[0025] As mentioned above, devices according to the present invention can include air purifiers without fans. One such embodiment is depicted in FIG. 5, which illustrates a vent device 100 that purifies air via a photocatalytic oxidation process. Air vent device 100 has a generally rectangular housing 114 with a control unit 134 at one end. A light source 138 extends laterally from control unit 134 and is surrounded by a cylindrical shell of photocatalytic material 136 (such as a titanium oxide coated substrate). Contaminates in air passing through device 100, for example under the power of a central blower, deposit on material 136 and are catalytically oxidized with the energy supplied by light 138. A shield 130 prevents light from source 138 from spilling through grill 122 in face plate 110 and into the room. An air vent device having a UV filter can be constructed substantially identically as device 100 save that in UV filtration there would typically be no need for material 136 surrounding the light.

CLOSURE

[0026] While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character. Only certain embodiments have been shown and described, and all changes, equivalents, and modifications that come within the spirit of the invention described herein are desired to be protected. Further, any theory, mechanism of operation, proof, or finding stated herein is meant to further enhance understanding of the present invention and is not intended to limit the present invention in any way to such theory, mechanism of operation, proof, or finding. Thus, the specifics of this description and the attached drawings should not be interpreted to limit the scope of this invention to the specifics thereof. Rather, the scope of this invention should be evaluated with reference to the claims appended hereto.

[0027] In reading the claims it is intended that when words such as “a”, “an”, “at least one”, and “at least a portion” are used there is no intention to limit the claims to only one item unless specifically stated to the contrary in the claims. Further, when the language “at least a portion” and/or “a portion” is used, the claims may include a portion and/or the entire items unless specifically stated to the contrary. Likewise, where the term “input” or “output” is used in connection with an electric device or flow path, it should be understood to comprehend singular or plural and one or more signal channels or flow paths as appropriate in the context. Finally, all publications, patents, and patent applications cited in this specification are herein incorporated by reference to the extent not inconsistent with the present disclosure as if each were specifically and individually indicated to be incorporated by reference and set forth in its entirety herein.

What is claimed is:

1. A device for circulating air in a room having an air duct opening in the floor or in a wall of the room, the device comprising:

a housing configured to be inserted into the air duct opening, the housing defining a flange portion and a body portion and defining at least one air passageway therethrough, the flange portion being configured to rest on the wall or on the floor surrounding the duct opening and the body portion being sized to fit into the air duct when the flange portion is resting on the wall or on the floor surrounding the duct opening;

the housing containing at least one DC powered fan and an electronic control unit therefore, the electronic control unit adapted to receive DC power from an external AC/DC converter; and

a face plate defining at least one grill covering the fan, the face plate further defining a power cord opening for connecting the electronic control unit to the external AC/DC converter.

2. The device of claim 1 wherein the electronic control unit is wirelessly linked to a controller.

3. The device of claim 2 wherein the controller includes a thermostat.

4. The device of claim 2 wherein the air duct is one of a plurality of ducts from a central air heating or cooling unit and the controller is the controller of the central air heating or cooling unit.

5. The device of claim 2 wherein the controller is a handheld remote control.

6. The device of claim 1 further comprising a motion sensor for activating the device.

7. The device of claim 1 wherein the housing is unitary and the face plate further defines a recess to receive at least a portion of a cord from the external AC/DC converter.

8. The device of claim 1 further comprising an air purification unit.

9. The device of claim 8 wherein the air purification unit includes at least one of static electricity filter, ozone generator, UV generator, negative ion generator and photocatalytic oxidation.

10. The device of claim 9 wherein the at least one fan is disposed between the air purification unit and the face plate.

11. A device for purifying air in a room having an air duct opening in the floor or in a wall of the room, the device comprising:

a housing configured to be inserted into the air duct opening, the housing defining a flange portion and a body portion and defining at least one air passageway therethrough, the flange portion being configured to rest on the wall or the floor surrounding the duct opening and the body portion being sized to fit into the air duct when the flange portion is resting on the wall or on the floor surrounding the duct opening;
an air purification unit coupled to the body portion of the housing, the air purification unit including at least one of static electricity filter, ozone generator, UV generator, negative ion generator and photocatalytic oxidation;

an electronic control unit in the body portion of the housing; and

a face plate having at least one grill covering the housing, the face plate defining an outer face facing the interior of the room wherein, when the device is installed in the air duct opening, the outer face is not more than 1.5 inches from a plane defined by the wall or floor surrounding the opening.

12. The device of claim 11 wherein the face plate includes first and second grills and a control panel positioned between the grills.

13. The device of claim 11 further comprising first and second fans mounted in the housing.

14. The device of claim 13 further comprising a control panel on the face plate, wherein the fans operate at one of at least three different speeds and the control panel includes a visual indicator for indicating which of the three different fan speeds have been selected.

15. The device of claim 11 further comprising a temperature sensor for determining the temperature of air being forced through the duct.

16. The device of claim 11 wherein the electronic control unit is wirelessly linked to a controller.

17. The device of claim 11 wherein the electronic control unit receives DC power from an external AC/DC converter.

18. A device for circulating air in a room having an air duct opening in the floor or in a wall of the room, the device comprising:

a unitary plastic housing configured to be inserted into the air duct opening, the housing defining a flange portion and a generally rectangular body portion configured to be recessed into the air duct opening when the flange portion is resting on the wall or on the floor surrounding the duct opening;

first and second DC powered fans positioned in the housing for circulating air in the room;

an electronic control unit for activating the fans; and

a face plate coupled to the housing and defining first and second grills covering the fans.

19. The device of claim 18 further comprising an air purification unit.

20. The device of claim 19 wherein the air purification unit includes an ozone generator, a source of UV light, a static electricity filter or a source of negative ions.

21. The device of claim 18 further comprising a motion detector coupled to the electronic control unit.

22. The device of claim 18 wherein the fans are powered by a battery in the housing.

23. The device of claim 18 further comprising a temperature sensor, wherein the electronic control controls the fans based on a signal received from the temperature sensor.

24. The device of claim 23 wherein the electronic control has a memory for storing temperature data and a processor for executing logic to control operation of the fans based on stored temperature data.

25. A system, comprising:

a housing configured to be inserted into an air duct opening, the housing defining a flange portion and a body portion and defining at least one air passageway therethrough, the flange portion being configured to rest on the wall or on the floor surrounding the duct opening and the body portion being sized to fit into the air duct when the flange portion is resting on the wall or on the floor surrounding the duct opening;

at least one of a fan and an electrically powered air purification device in the housing;

an electronic control unit in the housing for controlling at least one of a fan and an electrically powered air purification device;

a face plate having a grill; and

an AC/DC converter for supplying DC power to the electronic control unit from a wall outlet.

26. The system of claim 25 wherein the housing is a unitary plastic housing.

27. The system of claim 25 wherein the fact plate includes a control panel.

28. The system of claim 25 further comprising a motion sensor.

29. A device for insertion into an air duct opening in a room wherein the air duct conveys air from a central furnace or air conditioner to the room, the device comprising:

a unitary housing defining a flange portion and a body portion, the flange portion being configured to rest on the wall or on the floor surrounding the duct opening and the body portion being sized to fit into the air duct when the flange portion is resting on the wall or on the floor surrounding the duct opening;

the housing containing an electronic control unit and at least one fan for boosting the air flow from the central furnace or air conditioner into the room;

wherein the electronic control unit is electrically connected to the central furnace or air conditioner and receives electrical power directly therefrom.