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(54) LOW-RESISTANCE, DISCHARGE-VENT SOFFIT FRAME

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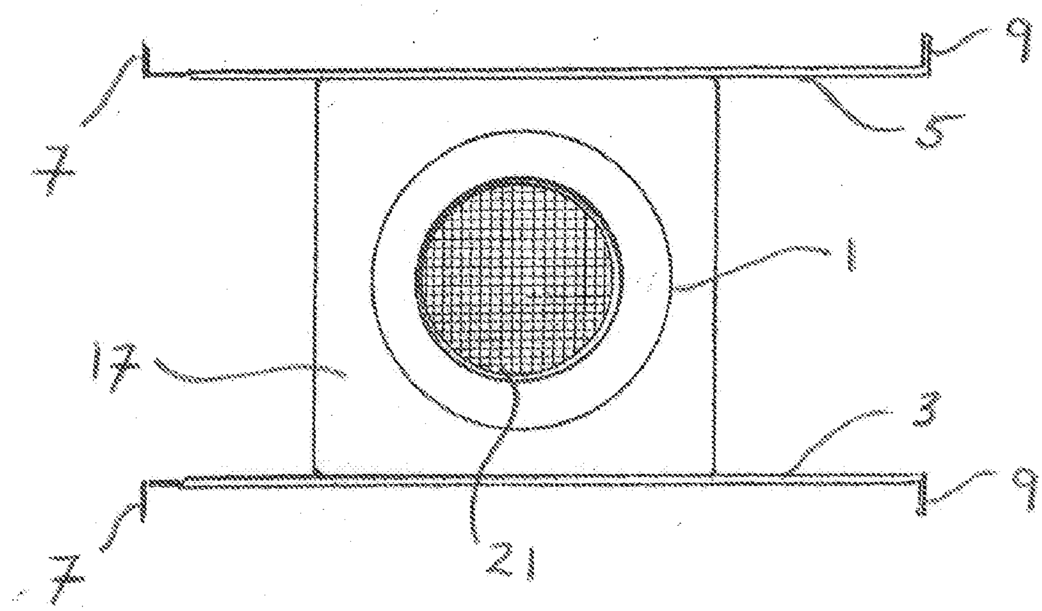
(57) **ABSTRACT**

One version of the invention is a low-resistance, discharge-vent soffit frame. The inventive frame is deployed as part of a ventilation system in which air is discharged outside a building, such as a home. The frame includes a hollow connector having an intake opening and an output opening, through which air is directed to the home's exterior. The discharge-vent soffit frame typically includes two adjustable members—one on either side of the hollow connector—that attach between the eaves and side of a building. A low-resistance, discharge-vent soffit frame of the present invention is installed before, not after, a soffit is installed between the eaves of a building and the building side from which the eaves project.



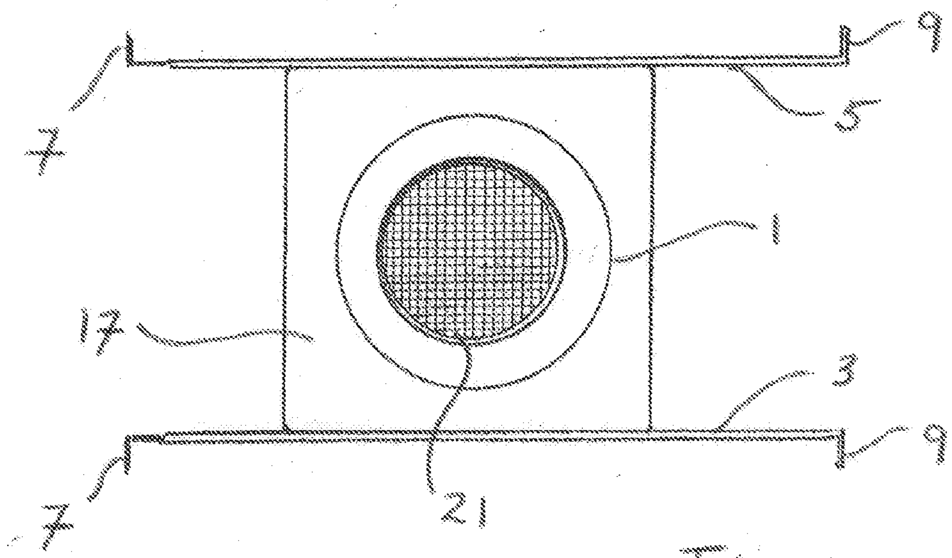


Fig. 1

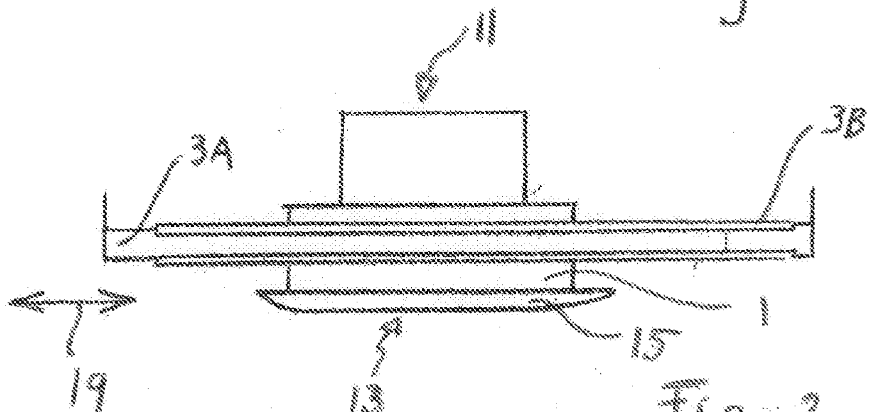


Fig. 2

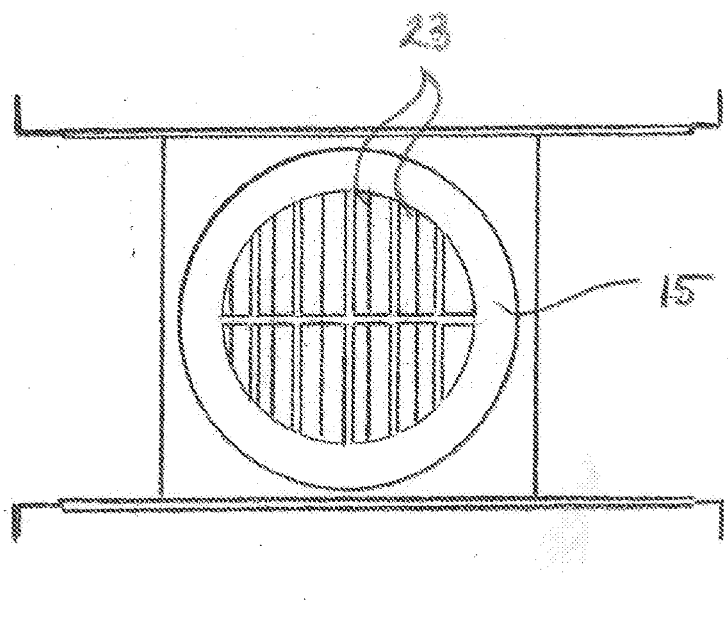


Fig. 3

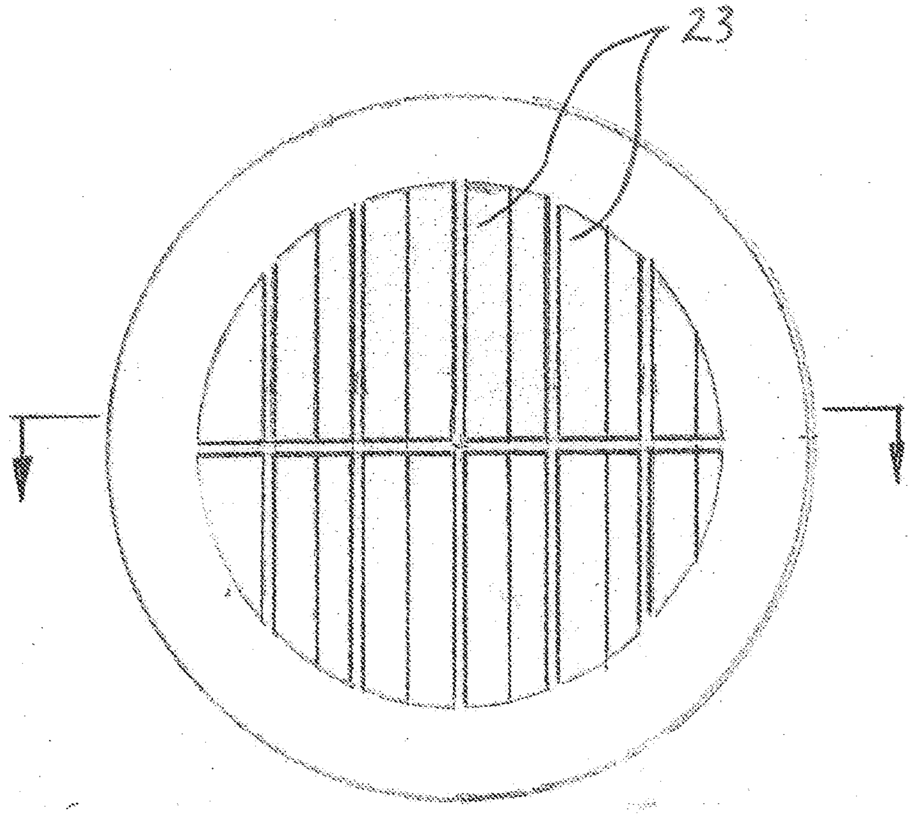


Fig 4.

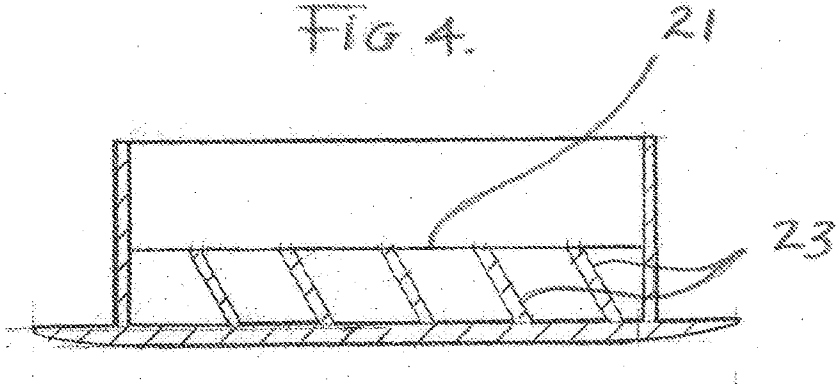


Fig. 5

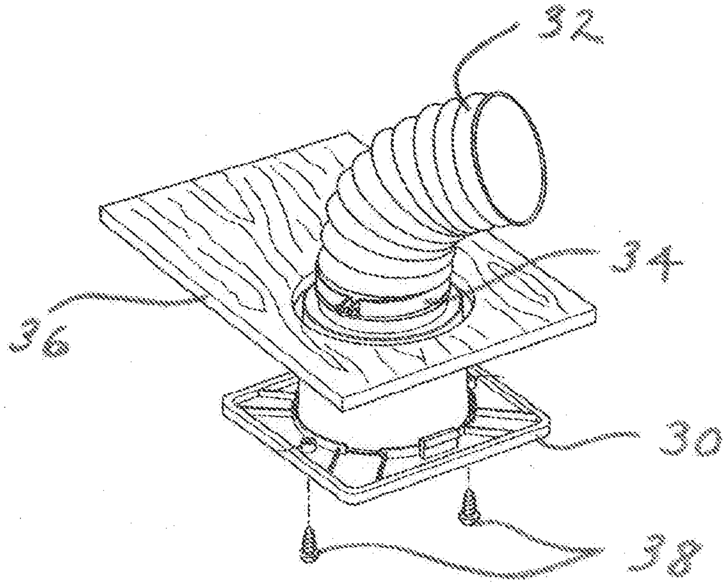


Fig. 6 (Prior Art)

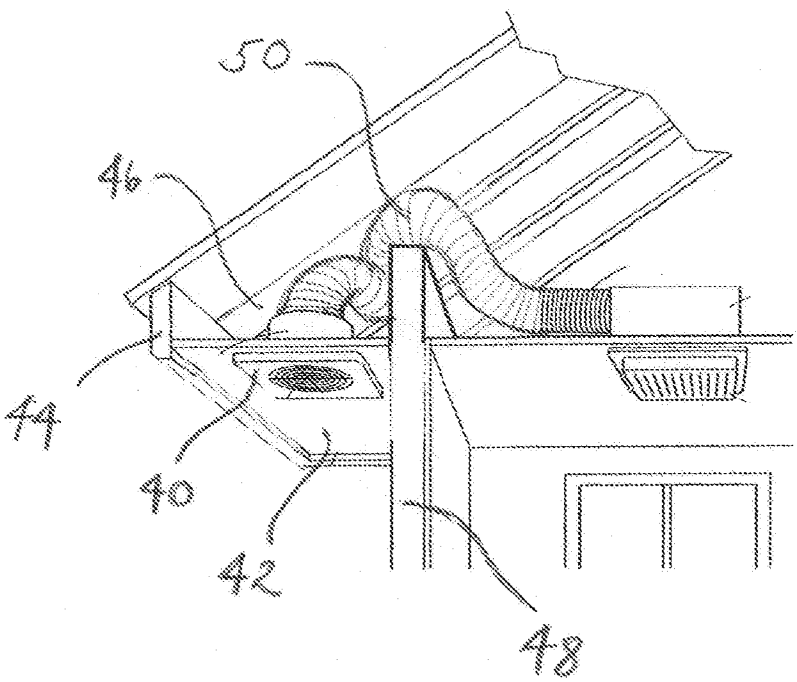


Fig. 7 (Prior Art)

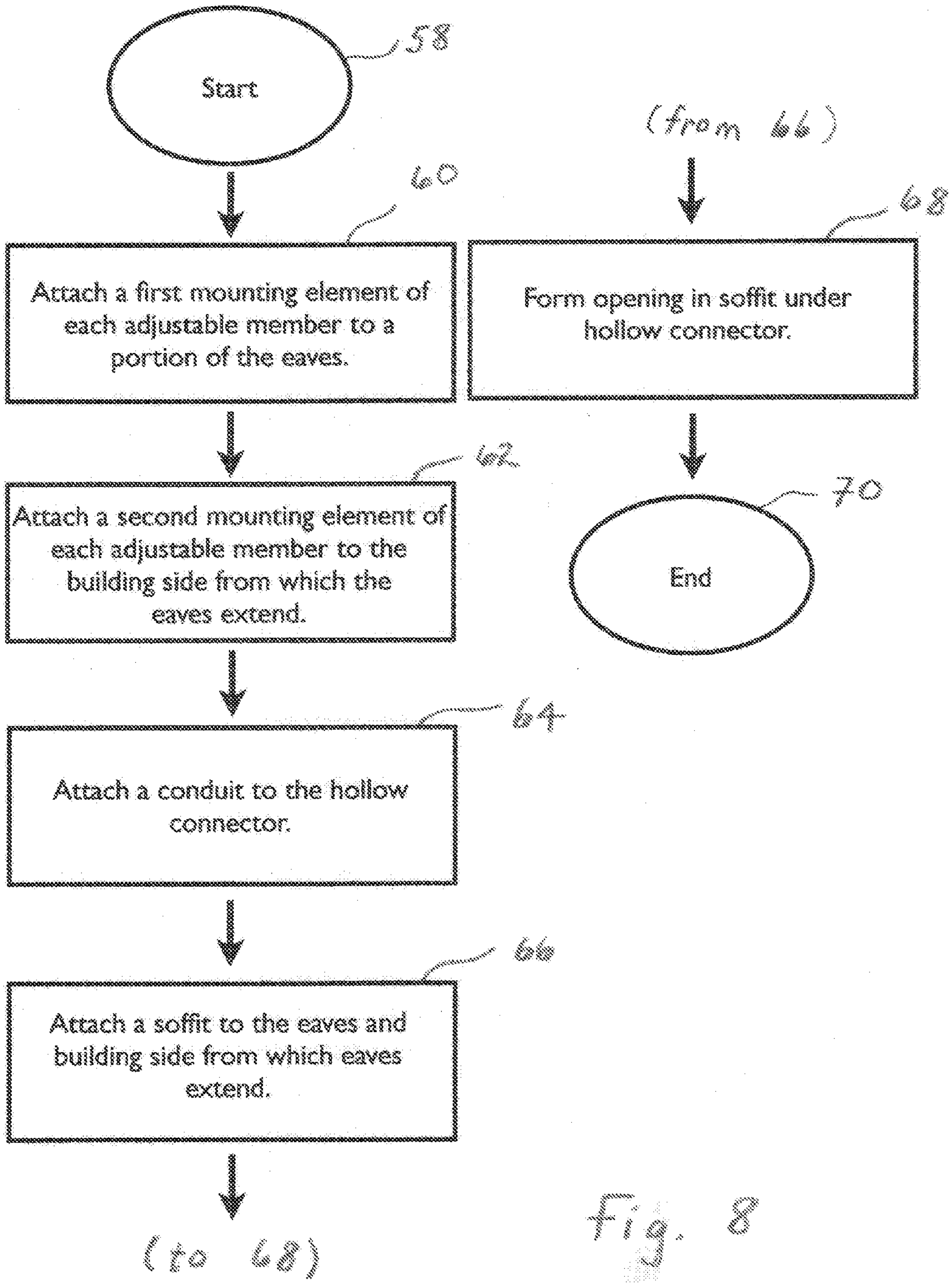

Start
58
60
Attach a first mounting element of each adjustable member to a portion of the eaves.
62
Attach a second mounting element of each adjustable member to the building side from which the eaves extend.
64
Attach a conduit to the hollow connector.
66
Attach a soffit to the eaves and building side from which eaves extend.
(to 68)
(from 66)
68
Form opening in soffit under hollow connector.
70
End

Fig. 8

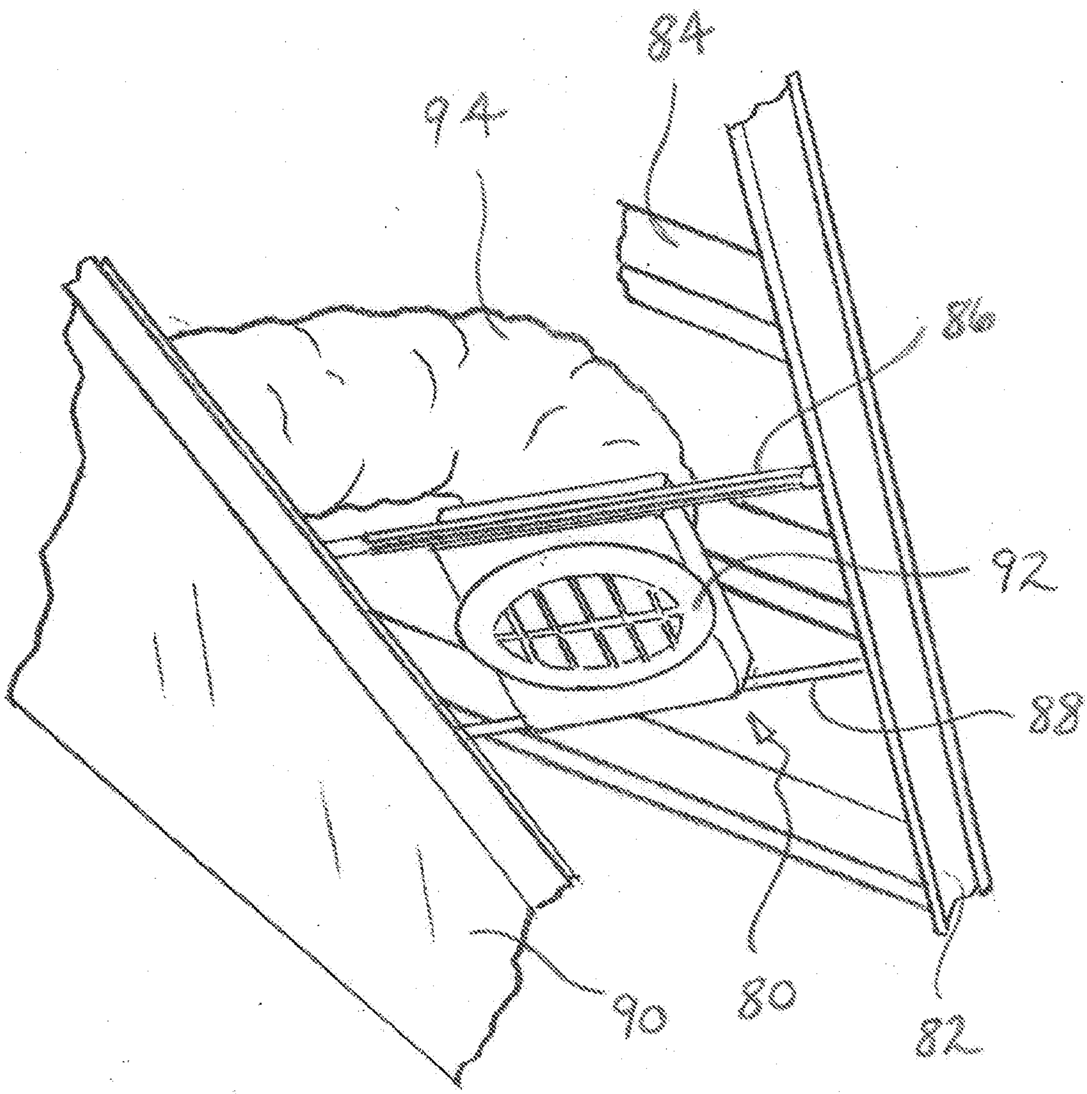


FIG 9

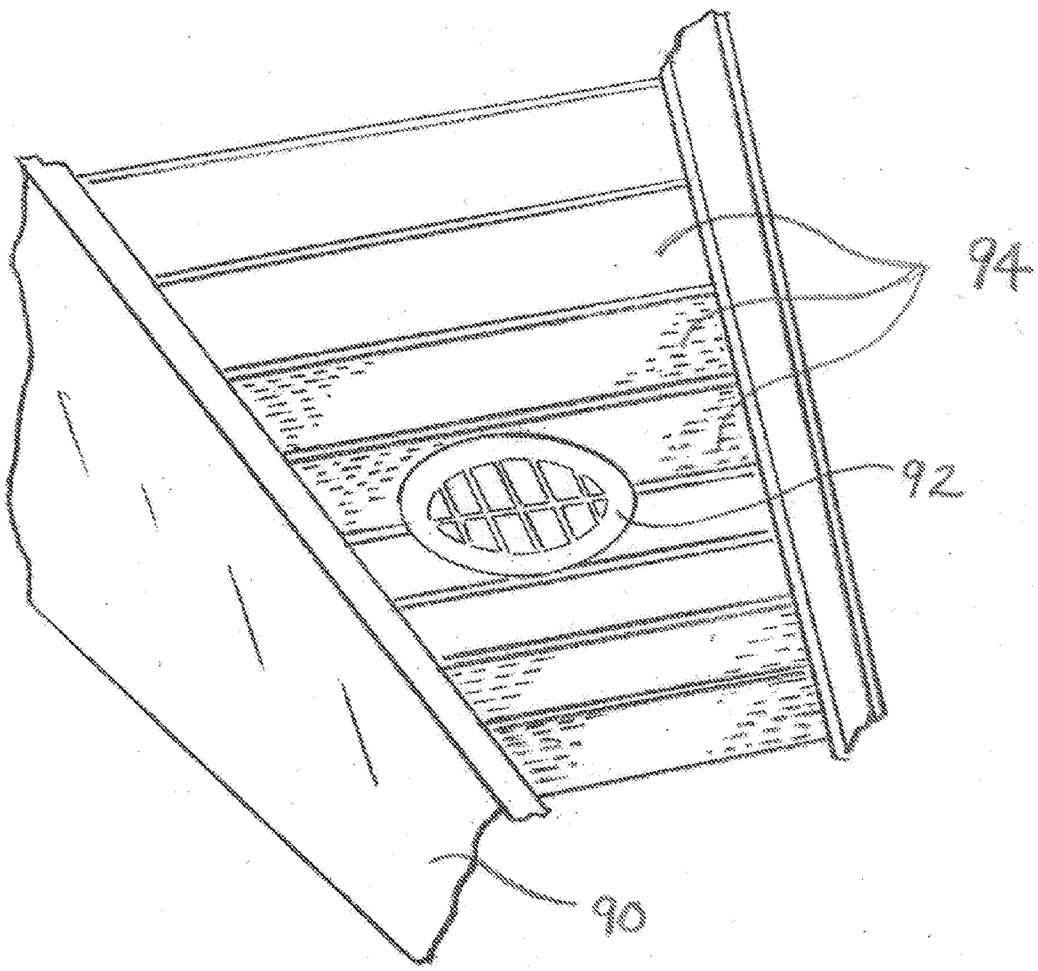


FIG. 10

LOW-RESISTANCE, DISCHARGE-VENT SOFFIT FRAME

BACKGROUND

[0001] More and more. Faster and faster. These phrases are the mantra of business today, including the business of constructing homes. There is nothing wrong with building a house with more living space, in less time, using fewer people and with cheaper materials. Unless, that is, quality is compromised. And quality is being compromised when it comes to selecting the components for, and installing, bathroom ventilation systems in homes.

[0002] Often a general contractor has overall responsibility for completing the project of building a home. The general contractor hires, or engages as sub-contractors, concrete workers, framing carpenters, finish carpenters, roofers, people to install a heating-and-air-conditioning system, electricians, plumbers, and others. A general contractor may delegate to some of these workers the responsibility for ensuring that a project milestone is achieved, or that a subsystem in the home is in working order and meets project specifications. For example, a subcontractor is usually responsible for installing a heating-and-air-conditioning system and making sure it works. An electrician is typically responsible for installing an electrical system, and ensuring that all wiring, outlets, light switches, light fixtures, fuses/circuit breakers, and other related components work.

[0003] Unfortunately, no single person is responsible for the selection of components for, and correct installation of, an effective and efficient bathroom ventilation system (a bathroom ventilation system typically includes at least three components: a bathroom ventilation fan; a discharge vent at the building's exterior; and a duct connecting the discharge vent to the ventilation fan's exhaust port). Drawings, including those done by architects, rarely show where, precisely, a ventilation fan is to be installed in a bathroom. Also, drawings infrequently show where an external discharge vent is to be located, or how the discharge vent is to be connected to the bathroom ventilation fan. Furthermore, the system as a whole, when complete, is typically not tested to check, for example, whether the measured air flow of the system is comparable to the rated air flow of the chosen ventilation fan. In other words, most home building plans do not treat bathroom ventilation as a system of interrelated components, components that must be selected, placed, and connected in a way that produces an effective and efficient system. Instead, in the interest of building more and more house, faster and faster, the bathroom ventilation system is not thought of, or treated, as an integrated system requiring care and planning.

[0004] As a result, components of the system are typically chosen in piecemeal fashion, without regard to the functioning of the system as a whole. For example, an electrician, after the house has been roughed in, may walk through the house with the general contractor and owner-to-be, making on-the-spot decisions as to where electrical outlets, electrical switches, and fans (such as the bathroom ventilation fans) will be located. As noted above, the location of the bathroom fan is almost always absent from the building plans, and so aesthetics, owner preference, and cost are key factors in selecting and placing many a ventilation fan. Furthermore, selection of the ventilation fan itself may be left to the electrician, or the general contractor may ask that a specific grade of fan be purchased (e.g., a general contractor may ask for, or an electrician may choose, a "builder-grade" fan from a local building supply store; the phrase "builder-grade" typically denotes inexpensive or standard materials and components). When the electrician installs the selected fan, he or she may or may not orientate the fan housing so that the distance between the exhaust port of the fan, and the discharge vent at the building's exterior, is as short as possible (the longer the duct connecting the exhaust port of the fan to the discharge vent, the greater the resistance to air flow, thereby reducing the volumetric flow rate of air; also, if the duct or conduit follows a more tortuous path, with more bends and the possibility of a pinch point or other deformation, this too will likely result in reduced air flow).

[0005] As with the selection of the ventilation fan, so with the selection of the ventilation system's building-exterior discharge vent. Discharge vent designs vary. Some are located at the side of the building. Some project from the roof. And some are located in a building's soffit (a soffit typically consists of horizontal panels of aluminum, wood, or other material placed between the end of the eaves [or fascia extending downward from the eaves], and the building side from which the eaves project).

[0006] Soffit discharge vents are often designed primarily with aesthetics in mind, rather than the effectiveness of the ventilation system. Some soffit discharge vents result in substantial reductions of air flow, either immediately after installation (e.g., because the design of an exit grille—i.e., that portion of the discharge vent that is visible to an observer—inherently produces a substantial reduction of air flow), or over time (e.g., due to use of a relatively fine mesh screen to keep bugs, birds, or other animals out of the ventilation system but which, over time, becomes plugged with dust or debris—thus significantly reducing air flow). Also, some soffit discharge vents discharge air straight down and parallel to the building side. Air may re-penetrate the home through the siding, or upward through the soffit (especially if the soffit is vented—i.e., includes apertures that permit the flow of air through the soffit). If the air is humid (e.g., because it is discharged from a bathroom), then re-penetration of the air may lead to moisture-related problems (including, for example, mold).

[0007] Cost often drives selection of a duct, pipe, or conduit used to connect the exhaust port of a bathroom ventilation fan to the building-exterior discharge vent. For example, the conduit may be a flexible, accordion-style material that is easily pinched during placement and installation, thus significantly reducing air flow (e.g., akin to a garden hose pinching, resulting in reduced or stopped water flow). Furthermore, the interior surface of the duct may be rough or have an undulating surface, resulting in significant reduction in the flow rate of air.

[0008] In addition to the aforementioned design problems, components of a bathroom ventilation system are typically installed at different times, and by different people, in a way that does not emphasize the effectiveness of the system as a whole. A bathroom ventilation fan might be installed that has a rated volumetric flow rate of 100 cubic feet per minute (cfm). Yet the measured volumetric flow rate at the discharge vent of the bathroom ventilation system might be only 70 cfm, or less, due to component selection and installation problems.

[0009] Historically there appears to have been no widespread impetus to improve the effectiveness of bathroom ventilation systems. Applicable regulations often require only that a system produce some minimum measured volumetric flow rate for spot ventilation (e.g., in 2013, applicable Wisconsin regulations require that a bathroom ventilation system achieve a minimum air flow rate of 50 cubic feet per minute). Furthermore, consumers typically do not complain if a bathroom mirror fogs up when the bathroom ventilation fan is running. They simply accept sub-standard performance of the bathroom ventilation system, without being aware that the typical fan is operating far from its rated air flow rate because of the manner in which the components of the ventilation system were selected and installed.

[0010] But times are changing. Because of environmental concerns and society's focus on energy efficiency, homes are being built that are "tight": i.e., they allow less air in or out. As modern homes become "tighter," the exchange of air, driven by mechanical ventilation, becomes more and more important. In fact, whole-house ventilation becomes important (whole-house ventilation denotes continuous operation of the ventilation system; spot ventilation denotes intermittent operation of the system). Accordingly, there is a need for a novel soffit discharge vent, and a method for installing components of a bathroom ventilation system that include such a soffit discharge vent.

SUMMARY

[0011] One version of the invention is a low-resistance, discharge-vent soffit frame. The frame includes a hollow connector having an intake opening and an output opening, through which air is directed to the exterior of a home. The discharge-vent soffit frame typically includes two adjustable members—one on either side of the hollow connector—that attach to the building. The mounting element at one end of each adjustable member attaches to the eaves (or, as discussed below, to fascia extending downward from the end of the eaves). The other mounting element at the opposing end of each adjustable member attaches to some portion of the building side from which the eaves extend (with the discharge-vent soffit frame, in the usual case, substantially perpendicular to the building side to which the discharge-vent soffit frame is attached). The distance between the opposing ends of the discharge-vent soffit frame is typically adjustable to account for the varying distances between the eaves and building side from which the eaves project. Because the low-resistance, discharge-vent soffit frame is attached to the building independent of placement of a horizontal soffit between the end of the eaves and the building side from which the eaves extend (with the soffit typically perpendicular to the building side), the frame is installed before the soffit is installed. As a result, the bathroom ventilation fan and low-resistance, discharge-vent soffit frame may be installed, and connected to one another using a conduit, on the same day and by the same person.

[0012] The novel low-resistance discharge-vent soffit frame, and methods of installing a ventilation system that include the frame, may be contrasted with current construction practices. At present, the bathroom ventilation fan might be installed by an electrician on a given day once the building is roughed in—perhaps with a standard length of conduit attached to the fan's exhaust port—and then left for two or more weeks until other workers attach the soffit and siding to the building. The end of the conduit not yet connected to a soffit vent is generally left open to the environment. Birds, especially in the Spring of the year, may enter the conduit opening and build a nest. "Finishers," when adding the soffit, rout a hole in one or more soffit panels, then pull the conduit through the hole and attach a soffit vent to the end of the conduit (generally any excess conduit is not removed, as this would take additional time and effort for which the worker—the "finisher"—is not paid). After the soffit vent is attached to the conduit, the conduit is pushed upward and back through the hole in the soffit panel (or panels) until the soffit vent contacts the soffit. The conduit may pinch or collapse, or form a more tortuous path, all of which increase resistance to air flow. The finisher then attaches the soffit vent to the soffit (e.g., by using screws). At a minimum, the inventive low-resistance, discharge-vent soffit frame allows for, but does not require, same-day installation of the entire bathroom ventilation system. Furthermore, the inventive frame, because it is installed before the soffit panels are installed, allows for more room and greater access to stretch and/or trim the conduit before attaching the conduit to the low-resistance, discharge-vent soffit frame.

[0013] The low-resistance, discharge-vent soffit frame preferably includes a wire or plastic screen to prevent birds from entering the bathroom ventilation system. Typically the screen is relatively coarse, unlike finer mesh screens employed in some current soffit vents, to avoid the problem of dust buildup and degraded air flow.

[0014] The low-resistance, discharge-vent soffit frame preferably includes an air diffuser that directs exhausted air out of the discharge vent and away from the home (to minimize or reduce the amount of moist, exhausted air re-entering the building, such as through vented soffit panels near the discharge vent).

[0015] Another version of the invention is a method for installing a bathroom-ventilation system. Typically the method includes the steps of: providing a low-resistance, discharge-vent soffit frame that includes a hollow connector attached to two adjustable members, each member having a mounting element at its opposing ends; attaching the mounting elements at one end of each member to the eave (or a fascia board extending downward from the eave); attaching the mounting element at the opposing end of each adjustable member to the building side; providing a conduit having opposing ends; attaching one end of the conduit to the hollow connector of the low-resistance, discharge-vent soffit frame; attaching a soffit to the eaves and building side from which the eaves extend; and forming an opening in the soffit under the hollow connector. The method may include other steps, such as the step of installing a bathroom ventilation fan having an exhaust port; and the step of connecting the conduit to the exhaust port of the bathroom ventilation fan. As noted above, preferably the preceding steps are carried out in a single day by the same worker, likely an electrician. But, if need be, one or more of these steps may be carried out on different days, and by different people. Note also, that after a soffit is installed, an air diffuser may be attached to the hollow connector.

[0016] The preceding inventive method may include one or more additional steps: the step of reducing the length of the conduit prior to attachment of the conduit to the low-resistance, discharge-vent soffit frame; the step of measuring the air flow of the installed bathroom ventilation system; the step of selecting a bathroom fan having a rated air flow rate that exceeds the air flow rate recommended for whole-house ventilation of a home having a given square footage in which a certain number of occupants reside.

[0017] These and other representative embodiments of the low-resistance, discharge-vent soffit frame, and methods for installing bathroom ventilation systems that include such frames, are described below.

DRAWINGS

[0018] FIG. **1** shows a top view of one representative version of a low-resistance, discharge-vent soffit frame.

[0019] FIG. **2** shows a side view of one representative version of a low-resistance, discharge-vent soffit frame.

[0020] FIG. **3** shows a bottom view of one representative version of a low resistance, discharge-vent soffit frame.

[0021] FIG. **4** shows a bottom view of one representative version of a diffuser used with a low-resistance, discharge-vent soffit frame.

[0022] FIG. **5** shows a view of a cross section of the representative version of the diffuser depicted in FIG. **4**.

[0023] FIG. **6** shows a perspective drawing of the manner by which a prior-art soffit vent, with a conduit already attached, is positioned and attached to a soffit.

[0024] FIG. **7** shows a perspective drawing of a cross section of a home in which a prior-art soffit vent is attached to a conduit, which in turn is attached to a ventilation fan.

[0025] FIG. **8** shows one version of a method for installing a low-resistance, discharge-vent soffit frame of the present invention.

[0026] FIG. **9** shows a perspective view of one representative version of a low-resistance, discharge-vent soffit frame placed between eaves and a building side from which the eaves project.

[0027] FIG. **10** shows a the same view as FIG. **9** after the soffit is installed.

DESCRIPTION

[0028] FIGS. **1**, **2**, and **3** show a top view, side view, and bottom view, respectively, of one representative version of a low-resistance, discharge-vent soffit frame of the present invention. The top view of the version of the frame shown in FIG. **1** includes a hollow connector **1**; first and second adjustable members (**3** and **5**, respectively) attached to, or integrally part of, the hollow connector **1**; and first and second mounting elements (**7** and **9**, respectively) attached to, or integrally part of, each of the first and second adjustable members (note: as is explained in the paragraphs below, the version of the invention shown in FIGS. **1**, **2**, and **3** includes a pair of adjustable members **3** and **5**, each of which includes an arm inserted into, and slidably engaged with, a receiver arm, such that the combination of the arm and receiver arm may be lengthened or shortened during installation of the soffit frame).

[0029] In the version of the frame shown in FIG. **1**, the hollow connector is a cylinder with a circular cross-section. But the hollow connector may have differently shaped cross sections including, for example, an elliptical cross section, a rectangular cross section, or a square cross section. The hollow connector may take on different shapes so long as the resulting connector allows for the flow of air through its interior. It should be noted, though, that certain connector shapes may provide less resistance to the flow of air compared to other connector shapes. Also, the connector's shape may change along its length. For example, the connector may possess a rectangular cross section along some portion of its length, and a circular cross section along the remaining portion of its length (e.g., a portion of the connector's length may be shaped to correspond to the shape of a conduit to which the connector will be attached; thus a portion of the connector may be shaped to have a cylindrical cross section to match the cross section of a cylindrical conduit to which the connector will be attached).

[0030] The hollow connector may have a constant diameter or cross-sectional area along its length. Alternatively, the diameter, cross-sectional area, or other dimension of the hollow connector may change along its length (i.e., its size can change along its length). For example, the side view of the representative version of the inventive frame shown in FIG. **2** depicts a hollow connector having two different diameters: a smaller diameter in the upper portion of the connector nearest the connector's intake opening **11**; and a larger diameter in the lower portion of the connector nearest the connector's output opening **13** (note: FIG. **2** includes an optional diffuser **15**—shown in FIGS. **4** and **5** and discussed in more detail below—attached to the bottom portion of the connector **1**; the diffuser may be attached to the low-resistance, discharge-vent soffit frame in different ways, including, for example, a friction fit between a portion of the inner surface of the lower portion of the hollow connector and the outer surface of a portion of the diffuser). Typically the upper portion of the hollow connector **1** (i.e., that portion closest to the intake opening **11**), will have an outside diameter such that the upper portion of the hollow connector readily attaches to a pipe, duct, conduit, or other structure by which the frame is connected to a ventilation fan. For example, if the connector is a cylinder, the upper portion will typically possess a 4-inch or 6-inch outside diameter so that a conduit with a 4-inch or 6-inch inside diameter will readily attach to the connector. Alternatively, the upper portion of the connector may step down from a 6-inch diameter along some portion of its length to a 4-inch diameter, thus being configured to attach to a conduit having either a 6-inch inside diameter or a 4-inch inside diameter.

[0031] It should be noted, though, that the inventive frame is not limited to hollow connectors having these recited diameters (or, indeed, as mentioned above, having a diameter, in that the hollow connector may have other cross-sectional shapes such as a rectangular shape). Nor is the inventive frame limited to a conduit attaching to the hollow connector by fitting over the outside of the upper portion of the hollow connector. For example, a conduit may be fit inside the upper portion of the hollow connector. Or a conduit and hollow connector may be attached to one other using a some form of joint, flange, or butt connector. The hollow connector of the low-resistance, discharge-vent soffit frame may be attached to a conduit using any conventional mechanical attachment, joint, fastener, clip, tabs, clamp, tape, zip or cable tie, or other such article, so long as the hollow connector and conduit, once attached, allow air to be conveyed by the conduit to, and through, the hollow connector (and, ultimately, to the exterior of the building).

[0032] It should also be recognized that the hollow connector need not be straight, but may be shaped or made to include a bend, such as a right-angle bend. In some versions of the invention, the hollow connector includes a right-angle bend such that a portion of the hollow connector is horizontal. Shaping the hollow connector in this way facilitates the incorporation of certain conventional backdraft-damper designs into the interior of that portion of the hollow connector that is horizontal (e.g., one version of a conventional backdraft-damper design opens in the presence of positive air pressure or velocity acting on the side of the damper closest to the ventilation fan; and, in the absence of such air pressure or velocity, the force of gravity causes the damper to close). Other backdraft damper designs, such as one employing a cloth-like cape, which blocks air flow from the exterior of the house into the interior of the house, may also be used.

[0033] The low-resistance, discharge-vent soffit frame is typically made of metal, plastic, or some combination of these materials. For example, sheet metal may be used to form the hollow connector, adjustable members, and mounting elements. Alternatively, one or more parts of the frame may be made of plastic (e.g., through injection molding). Individual components used to make a low-resistance, discharge-vent soffit frame may be attached to one another in various conventional ways, using, for example, adhesives; welds; fasteners; rivets; solder; screws; clips; clamps; and the like. In some versions of the invention, sheet metal may be stamped to make a die-cut blank, which is then converted (e.g., by folding, stamping, bending, and other operations) into a finished article (or portions of the finished article). It should also be noted that seams or other locations, such as those that may occur during fabrication of the hollow connector portion of the inventive soffit frame, may be sealed using a thermoplastic or other sealant material. Any conventional manufacturing process (e.g., sheet metal fabrication), including combinations of automated processes and manual operations, may be used to make the low-resistance, discharge-vent soffit frame.

[0034] The version of the frame shown in FIG. **1** shows a panel **17** to which the hollow connector **1** and adjustable members **3** and **5** are attached. But such a panel is not necessary: the adjustable members **3** and **5** may be attached directly to the hollow connector **1**. Nevertheless, the configuration depicted in FIG. **1** is preferred for some embodiments, in that the presence of the panel likely provides structural integrity to the frame as a whole, and, typically, should facilitate fabrication (especially when sheet metal is used to fabricate at least a portion of the frame).

[0035] The version of the frame shown in FIGS. **1**, **2**, and **3** includes adjustable members **3** and **5**. The depicted adjustable members, one of which is shown in the side view depicted in FIG. **2**, includes an arm **3**A that inserts into, and slidably engages with, a receiver arm **3**B. Adjustable member **5**, which is depicted in FIG. **1**, is not shown in FIG. **2** as it is directly behind adjustable member **3** in this side view. In one version of the invention the receiver arm **3**B is shaped to have a cross-section defining a channel, so that arm **3**A may be inserted into the channel. The channel's cross section may assume any shape (e.g., a C-shape, D-shape, square, or other cross section) so long as the arm **3**A may be inserted into, and be confined by, the channel—thus providing for expansion or contraction of the combination of the arm **3**A and receiver arm **3**B (the combination of which is denominated as an adjustable arm). In FIG. **2**, the double-headed arrow **19** signifies expansion or contraction of the adjustable arm, which is achieved by sliding arm **3**A within, and relative to, receiver arm **3**B (note: expansion and contraction of the adjustable arm is along the arm's longitudinal dimension). It should be noted that any mechanical feature that provides for the ability to fit the inventive low-resistance, discharge-vent soffit frame to the different distances that may be present between a portion of the eaves of a building (or any fascia extending from the eaves), and the building side from which the eaves extend, may be used. Often this mechanical feature will include a male element and a female element that engage one another, and are configured to move relative to one another.

[0036] As noted above, each of the adjustable arms **3** and **5** terminate in, or are attached to, mounting elements **7** and **9**. One pair of mounting elements, such as mounting elements **7** at the same end of each of the adjustable arms, may attach to either the eaves (or fascia extending from the eaves), or the building side from which the eaves extend. The second pair of mounting elements, mounting elements **9** at the opposing end of each of the adjustable arms, would then attach to whichever building structural element remains (eaves or building side) after mounting elements **7** have been attached.

[0037] Typically the mounting elements include a planar portion configured to be positioned adjacent to the building structure to which the mounting element is to be attached. For example, FIG. **1** shows a top view of each of mounting elements **7** and **9** comprising a planar portion substantially at a right angle to the adjustable members. Similarly, FIG. **2**, shows a side view of each of mounting elements **7** and **9** comprising a planar portion at a right angle to the adjustable members. The planar portions of each of these mounting elements may be positioned essentially adjacent to building structures, and then attached to the structure using screws, nails, staples, or other mechanical fastening elements. As an example, mounting elements **7** might be positioned adjacent to, and attached to, the substantially vertical side of a fascia board extending downward from the eaves. Mounting elements **9**, then, would be positioned adjacent to, and attached to, the building side from which the eaves extend. As noted above, the adjustable members permit a user to increase or decrease the distance between the opposing ends of each adjustable member. Accordingly, the inventive soffit frame may be placed in a variety of locations at a position between the eaves and the building side from which the eaves extend.

[0038] It should be noted that the mounting element may take on various shapes and orientations. Typically the mounting element will include a flange-like flat portion that is substantially perpendicular to the longitudinal dimension of the adjustable member. Note, though, that the mounting element may be configured to be at some other angle relative to the longitudinal dimension of the adjustable arm. For example, the mounting element could extend from the end of an adjustable arm such that the plane that coincides with the flat portion of the mounting element is parallel, not perpendicular, to the longitudinal dimension of the adjustable arm. Such a configuration is useful when the mounting element is to be attached to the horizontal top surface of a building wall (e.g., to the top horizontal surface of top plate), rather than to the vertical side surface of a building wall.

[0039] The flange-like flat portion of the mounting element may form any shape, and may extend in any direction from the end of the corresponding adjustable arm, so long as the mounting element is capable of being joined to the building structure to which the low-resistance, discharge-vent soffit frame is being attached.

[0040] All mounting elements may be identical. Or mounting elements on one end of the frame (e.g., those mounting elements configured to attach to the eaves or fascia extending from the eaves) may be different from those mounting elements at the opposing end of the frame (e.g., those mounting elements configured to attach to the top or side of a building wall from which the eaves extend).

[0041] In some versions of the invention, the mounting elements may be bent, crimped, or otherwise adjusted to achieve closer placement of the mounting element to the building structural element to which the mounting element is to be attached. For example, any flange-like flat portion of the mounting element may comprise metal that is sufficiently thin such that the flat portion may be bent to some desired angle relative to the longitudinal dimension of the adjustable arm.

[0042] In preferred versions of the invention, the mounting elements include one or more holes or slots to facilitate attachment of the inventive soffit frame to the adjacent building structure. For example, the mounting element may include one or more spaced-apart holes through which nails or screws may be used to attach the mounting element (and, therefore, the inventive frame) to the material of which the building structure is made (often the material will be wood, sheeting, and other such materials used in constructing buildings). Also, in some versions of the invention the mounting element may include one or more pre-set nails or pre-set screws attached to the mounting element and ready to be driven into the material with which the mounting element will be joined. Also, nails, screws, and other fasteners may be provided (e.g., in a separate plastic bag or container) with the inventive soffit frame for such attachment of the mounting elements to the building.

[0043] In some versions of the invention, the mounting elements at one end of the low-resistance, discharge-vent soffit frame include a shape, such as a U-shape, which is configured to receive the lower portion of a fascia board extending vertically downward from the eaves. The mounting element comprising this U shape may then be attached using nails, screws, or other fasteners. The unattached, opposing end of the frame may then be adjusted up or down until the frame is level, with the U-shaped portion of the mounting element, positioned against the bottom portion of the fascia board serving as a pivot point. Once the frame is level, then the frame may be attached using the aforementioned screws, nails, staples, fasteners, etc. It should be understood that any conventional design for the mounting elements may be used, so long as the inventive frame may be securely attached to the building or home.

[0044] FIG. **1**, a top view of one version of the low-resistance, discharge-vent soffit frame, shows a screen **21** attached to, in this case, the diffuser **15**. (Note: the depiction of the screen is not to scale; as is discussed generally below, a relatively coarse-mesh screen is preferred.) The function of the screen is to prevent birds or other animals from entering the hollow connector (and the conduit to which the hollow connector is attached). When buildings, such as homes, are built in the Spring, they are generally accessible to animals, especially birds seeking to build nests, for some portion of the timeline in which the home is built. As mentioned before, after the house has been roughed in, an electrician typically installs a ventilation fan in the bathroom (or in each of the bathrooms). The electrician may also, when installing a ventilation fan, attach a conduit of some standard length (e.g., 15 feet) to the exhaust port of the ventilation fan. If a conduit is attached to the exhaust port of the ventilation fan, then the opposing, un-attached end of the conduit is accessible to animals until the house is finished some weeks later. As was explained in the Background section above, a prior-art soffit vent to which the bathroom ventilation fan will discharge air is not installed until the soffit is attached. The soffit and siding are typically not added for at least a few weeks after the house has been roughed in. As a result, birds may enter the conduit and build a nest (especially in the Spring of the year), thereby compromising performance if not detected (or, if detected, potentially adding time and effort to installation of the ventilation system, depending on how far into a conduit the bird has built a nest).

[0045] To address this problem, some versions of the inventive low-resistance, discharge-vent soffit frame include a screen to prevent the entry of animals into the ventilation system. The screen may be attached to the hollow connector, or to any diffuser attached to the hollow connector, so long as the screen prevents the entry of animals into the ventilation system (e.g., by birds to build a nest). The screen is preferably attached to the hollow connector, because any optional air diffuser may not be connected to the low-resistance, discharge-vent soffit frame until after the soffit is installed. The screen may be attached to either the hollow connector or the diffuser by a friction fit, or using an adhesive, fastener, clip, weld, solder, or the like. Alternatively, if a component of the inventive frame is made of plastic, the screen may be incorporated into the plastic component during injection-molding of the component. The screen may be attached, or manufactured so as to be integral with, the frame using any conventional manufacturing method.

[0046] As noted above, the screen may be made of metal, plastic, or other material. It should noted that some manufacturers of prior-art soffit vents include screens of a relatively fine mesh. Likely the design intent is to prevent not only animals from entering the ventilation system, but also insects. The problem with this approach is that a fine-mesh screen may significantly increase air resistance, thus reducing the volumetric flow rate of air that the ventilation system is capable of discharging (and potentially significantly less than the rated air flow rate of the installed ventilation fan). This reduction in airflow may occur at the outset of installation, or sometime after installation, as dust and other debris buildup on the fine-mesh screen. Thus versions of the invention that include a screen typically include a relatively-coarse screen. An example of one such screen is a one-quarter-inch hardware cloth (one-quarter inch denoting the approximate size of the openings), made with, for example, 23 gauge wire, and available from most hardware stores (e.g., Ace Hardware, Home Depot).

[0047] FIGS. **2** and **3** show side and bottom views, respectively, of one version of a low-resistance, discharge-vent soffit frame. In the version shown in these figures, a diffuser **15** is depicted. The diffuser includes angled panels **23** that divert air flow at an angle to an imaginary vertical line passing downward through the center of the diffuser. The purpose of the diffuser is direct air discharged from the ventilation system—air that can be humid when the corresponding ventilation fan is located in a bathroom in the building—away from the side of the house. If humid air is discharged downward along a vertical path—i.e., along the side of the house—then the humid air may penetrate the materials of which the side of the house is made (e.g., siding); or the humid air may rise and enter into any attic space through the soffit (especially for vented soffit panels; i.e., soffit panels with openings); or both. By including a directional diffuser, versions of the inventive frame direct discharged air away from the side of the house, thereby reducing the re-penetration of discharged humid air back into the house (with the potential to cause, for example, mold under the siding, in the attic, etc.). One example of a diffuser includes angled panels that are about 1 inch apart, and positioned at an angle of about 30 to 40 degrees from a vertical plane or line.

[0048] As with other components of the inventive low-resistance, discharge-vent soffit frame, the diffuser may be made of metal, plastic, or other materials. Furthermore, as with other components, the diffuser may be fabricated using conventional manufacturing techniques (e.g., injection molded plastic; sheet metal fabrication; etc.). Also, the cross-sectional shape of the diffuser may be circular, rectangular, square, oval, or other shape. Typically the cross-sectional shape of the diffuser will be the same as the cross-sectional shape of the hollow connector of the soffit frame to which the diffuser attaches. The diffuser may be attached to the frame using threads, a friction fit, a snap-fit comprising some configuration of clips or protrusions that snap into place, or any other conventional configuration for attaching one component to another.

[0049] The low-resistance, discharge-vent soffit frame is installed before the soffit panels. The soffit panel or panels underlying the output opening of the hollow connector will be cut, routed, or otherwise processed to define an opening in fluid connection with the output opening of the hollow connector. The diffuser can serve not only to direct air, such as humid air, away from the house. The diffuser can also serve to cover any imperfections in the hole or opening in the soffit panel that is directly under the output opening of the hollow connector. FIG. **4** (bottom view of diffuser) and FIG. **5** (view of cross-section of diffuser along an imaginary plane designated by downward-pointing arrows on either side of the drawing in FIG. **4**) show one version of a directional air diffuser that may be used in conjunction with the inventive low-resistance, discharge-vent soffit frame. As noted earlier, the diffuser includes a series of parallel, angled panels **23**. This particular version of the diffuser also includes a screen **21**, interposed between the parallel, angled panels and the topmost portion of the diffuser. As noted earlier, the diffuser may not include a screen. Or a screen, rather than being part of the diffuser, may be incorporated into the interior of the hollow connector (which, as explained above, is preferred). Furthermore, just as conventional soffit vents can include screens that significantly reduce air flow, these same vents may incorporate diffuser designs or features that significantly reduce air flow. For example, some conventional soffit vents include a cover that directs air ninety degrees to the side of the vent. Such designs cause significant reductions in air flow.

[0050] The preceding paragraphs described the structural elements and features of the low-resistance, discharge-vent soffit frame. The following paragraphs describe methods for installing ventilation systems that include the inventive discharge-vent soffit frame. First, however, some context is provided by describing how ventilation systems are typically installed, and the attendant problems that occur.

[0051] As noted in the Background section above, building plans do not typically specify the model and location of the bathroom ventilation fan, the discharge vent at the building's exterior, and the conduit joining the ventilation fan to the discharge vent. Instead, during a walkthrough of the building, with an electrician, after the building is roughed in (e.g., before, for example, the siding and soffit are installed), the location of ventilation fans in bathroom ceilings is specified (along with, for example, other elements of the electrical system, such as the location of outlets, switches, etc.). Often the electrician then procures and installs a bathroom fan, possibly along with some standard length of conduit. This standard length typically exceeds the path of shortest travel from the bathroom ventilation fan to the closest location at which a soffit vent may be installed. After the electrician installs the bathroom fan, and if the electrician has purchased or otherwise acquired conduit, then the conduit will be attached only to the exhaust port of the ventilation fan. At the time the electrician installs the bathroom fan (i.e., when the building is roughed in), there is no soffit, and therefore no soffit vent. The conduit will be allowed to drape over one or more roof trusses, with any excess typically draped over the exterior wall. Frequently the open end of the unattached conduit is left exposed to the environment where birds, especially in the Spring, may build a nest.

[0052] Some weeks later various people undertake additional tasks to finish the house. For example, some workers, known as "finishers," are charged with installing the siding and soffit. Often, then, "finishers" are charged with the task of making the final attachments to complete the ventilation system. This is because current soffit vents are attached to the soffit, and so the worker installing the soffit also attaches a soffit vent to the soffit (after connecting the soffit vent to the conduit, which is drawn through an opening cut or routed in the installed soffit). FIG. **6** shows one arrangement by which a prior-art soffit vent is attached to a soffit (note: both FIGS. **6** and **7** are adapted from drawings from U.S. Pat. No. 6,149,516). The soffit vent **30** is attached to a conduit **32**, the other end of which is attached to the exhaust port of a ventilation fan (not shown). A clamp **34** is used to secure the conduit to the soffit vent. The conduit passes through an opening in the soffit **36** (note: a soffit often consists of a series of panels attached to the eave and the building side from which the eave extends). Although any excess conduit could be pulled through and trimmed to length before attaching the conduit to the soffit vent, this is not typically done. Instead, a sufficient amount of conduit is pulled through the opening in the installed soffit panel. The soffit vent is then attached to the end of the conduit, and the conduit is then pushed back into the opening in the soffit panel until the soffit vent contacts the soffit. Fasteners, such as screws **38**, are then used to attach the soffit vent to the soffit.

[0053] A not infrequent result is a coiled, pinched, or otherwise tortuous path between the soffit vent and the ventilation fan. FIG. **7** shows one example of this problem (note: as explained below, FIG. **7** shows a vertical building wall **48** extending upward and above a soffit **42**; in many buildings the ceiling in which the ventilation fan is installed would be approximately level with the topmost surface of this vertical wall, rather than below its topmost surface). A soffit vent **40** is attached to a soffit **42** in a manner like that described in the preceding paragraph. The soffit is attached to a fascia board **44** extending downward, vertically, from the eaves **46**; and to the building side **48** from which the eaves extend. The conduit **50**, which was pulled through the soffit opening, attached to the soffit vent, and then pushed back up through the opening so that the soffit vent could be secured to the soffit, is now coiled or pinched, thereby increasing resistance to air flow. This problem results, in part, because once the soffit is installed, access to the space between the soffit and the eaves is limited. A "finisher" outside the house, attaching a soffit vent to the installed soffit, is unable to see, or manipulate, that portion of the conduit that is located in this space (i.e., a worker is able to see and manipulate only that portion of the conduit that is pulled through the opening in the installed soffit). Also, this problem may be exacerbated when the vertical wall **48** extends upward and beyond an imaginary, horizontal plane that passes through the soffit (note: the ceiling depicted in the room to the right of FIG. **7** may also be flush with the topmost surface of wall **48**). The conduit must necessarily drape over this upward portion of the wall (and any structure associated with the adjacent ceiling), and can become pinched or bent as a result. As discussed below, the inventive low-resistance, discharge-vent soffit frame is installed before the soffit is installed, permitting workers greater access when making the final attachments that complete the ventilation system. Accordingly, the inventive article of manufacture and method provide for a more effective ventilation system because problems like those described above can be seen and addressed more readily.

[0054] One version of the inventive method is depicted in the flow diagram shown in FIG. **8**. Typically the low-resistance, discharge-vent soffit frame is attached to the house before the conduit is attached to the hollow connector of the frame. It should be noted that the present, conventional method for installing a ventilation system will generally not permit this approach. Because the soffit must be in place before a prior-art soffit vent is attached, (with reduced or no access to the conduit after the soffit vent is attached to the soffit), the conduit must be pulled through the opening in the soffit and attached to the prior-art soffit vent before the soffit vent is attached. The inventive frame, however, is attached to a building before a soffit is installed, thereby allowing access to the conduit (e.g., for attachment to the hollow connector) after the soffit frame is attached to the building. It should be noted, though, that the conduit may be attached to the inventive frame before the frame is attached to the building (e.g., for buildings having a roof with a relatively low pitch, and therefore less space).

[0055] Accordingly, at the method's start **58**, steps **60** and **62** involve attaching the first and second mounting elements of the adjustable members to the building. Steps **60** and **62** do not require a specific order: the low-resistance, discharge-vent soffit frame can be attached to the building wall first, and then the opposing end may be attached to a portion of the eaves (or a structure associated with the eaves, such as a fascia board). Also, if the low-resistance, discharge-vent soffit frame is modified to include a single adjustable member, then each of steps **60** and **62** could would require only that a single mounting element at opposing ends of the single adjustable member be attached.

[0056] Step **64** involves attaching a conduit to the hollow connector associated with the low-resistance, discharge-vent soffit frame. As described above, the conduit may be attached to the hollow connector in a number of different ways. Furthermore, as just described, step **64** can occur before steps **60** and **62**. Or, as depicted in FIG. **8**, the inventive soffit frame is first attached to the building and, because the inventive frame is installed before the soffit, workers generally have sufficient access to attach the conduit to the installed soffit frame. A potential benefit of the present invention includes the ability to use a smaller-diameter conduit because the low-resistance, discharge-vent soffit frame is designed to reduce or minimize resistance to air flow. As discussed elsewhere in the present application, many soffit vent designs inherently reduce air flow. Furthermore, many installations of ventilation systems result in a reduction in air flow (e.g., due to excess conduit between the ventilation fan and soffit vent; pinching of the conduit; the conduit having many twists and turns, thus increasing air resistance because of the tortuosity of the air-flow path defined by the conduit; etc.). To overcome these reductions in air flow, some in the industry adopt larger-diameter conduit (e.g., using a 6-inch diameter conduit rather than a 4-inch diameter conduit), or increase the power of the ventilation fan. Note that one disadvantage of increasing the diameter of the conduit is a reduction in the velocity with which air is discharged from the building (also, the limited space in some building roof designs may inhibit or make difficult the use of larger diameter conduit). A lower air velocity may increase the risk of re-penetration of the discharged air back into the building. The present invention, because it makes possible the complete installation of a ventilation fan, conduit, and low-resistance, discharge-vent soffit frame in a single day—before the installation of a soffit—readily allows for the complete installation of the bathroom ventilation system by a single person, thereby promoting accountability for efficient and effective performance of the system as a whole. Furthermore, by installing a ventilation system that is as efficient as possible (i.e., the measured volumetric flow rate of discharged air, measured at the fan intake, is as close as possible to the rated volumetric air flow rate of the installed ventilation fan). In other words, the present invention can help increase air flow rates compared to current, conventional ventilation systems, not by boosting horsepower or increasing conduit size, but by installing a low-resistance, discharge-vent soffit frame of the present invention (though, of course, the present invention encompasses those installations for which a larger conduit, or more powerful ventilation fan, are appropriate—e.g., for homes having more square footage; for building with more occupants; for homes in certain climates; etc.).

[0057] Step **66** occurs after steps **60**, **62**, and **64** (whatever the order of steps **60**, **62**, and **64**). Typically the soffit is installed by first attaching F-channel sections to the building side from which the eaves extend. For example, a series of inverted F-channel sections may be attached along the building side, at a location directly across from the bottom surface of a fascia board extending vertically downward from the eaves. The horizontal extensions of the inverted letter "F" (denominated as "bars" or "crossbars" in typeface anatomy) define a channel into which one end of a soffit panel is inserted. These bars extend outwardly from the structural element to which the channel section is attached, and are generally perpendicular to the surface of the structural element to which the channel is attached. Accordingly, one side of the soffit panel (normally a plurality of panels) is inserted into the channel of the inverted F channel section. And the other side of the soffit panel is attached to the bottom surface of the fascia board. A metal (e.g., aluminum) L-shaped panel may then be attached, with the lower, horizontal bar portion of the L extending over the attached soffit; and the vertical portion of the L attached to the fascia board. It should be noted that the present invention is compatible with other conventional methods of installing a soffit. It should be noted, too, that the present invention may be deployed such that the soffit frame of the present invention is attached directly to the rafter tail of the trusses defining the eaves, or other structural element of the eaves.

[0058] After the soffit panel, or panels, underlying the hollow connector of the soffit frame are installed, then an opening is created in the panel or panels directly under the output opening of the hollow connector (step **68** in FIG. **8**). The opening in the soffit panel is in fluid communication with the output opening of the low-resistance, discharge-vent soffit frame so that air may be exhausted out of the house. The opening may be created in any conventional manner. So, for example, if the soffit panels are made of metal, then shears or an automated routing tool may be used to create the opening in the soffit panel (or panels). Alternatively, an opening may be formed in a soffit panel or panels before the panels are installed below the low-resistance, discharge-vent soffit frame.

[0059] Typically vented soffit panels, unvented soffit panels, or both are installed. Vented soffit panels include apertures or openings in the panels, thus allowing air flow through the panel itself. Preferably unvented soffit panels are installed under the low-resistance, discharge-vent soffit frame to further inhibit the re-penetration of discharged humid air back into the house (e.g., when a bathroom ventilation fan discharges humid air from a bathroom).

[0060] As noted above, an air diffuser may be attached to the hollow connector after the soffit panels are installed; and after an opening has been formed in the panel or panels under the output opening of the hollow connector. Thus after step **68** in FIG. **8**, an air diffuser may be attached to the hollow connector (or, alternatively, to the soffit panel such that the air diffuser is directly under, and in fluid communication with, the output opening of the hollow connector). Typically the air diffuser is screwed into pre-existing threads incorporated into some portion of the interior of the hollow connector; friction fit into a portion of the interior of the hollow connector; snapped into place by, for example, positioning protrusions on the exterior surface of the upper portion of the air diffuser so that the protrusions engage openings in the hollow connector; or otherwise attached to the soffit vent frame of the present invention (or the soffit underlying the soffit vent frame). Any conventional manner by which elements are attached to one another may be used. Preferably the air diffuser is releasably engageable from the hollow connector, soffit frame, (or the soffit panel) such that the soffit frame of the present invention (and other components of the ventilation system) may be accessed if needed.

[0061] FIG. **9** shows one version of the present invention as installed using the above-described representative method. The low-resistance, discharge-vent soffit frame **80** is attached, at one end, to a fascia board **82** extending downward from the eaves **84**. The pair of adjustable members **86** and **88** have been lengthened (or contracted) so that the mounting elements contact the structural elements to which they are attached. In the depicted version of the invention, the mounting elements at one end of each of the adjustable members are attached to a fascia board **82**. The mounting elements at the other opposing end of the adjustable members are attached to the top of the vertical building side **90** opposite the fascia board. As noted earlier, the mounting elements can be attached to other portions of the building structure (e.g., to a truss defining the eaves; to the vertical surface, rather than top, of a building's wall or side; etc.). For completeness, an air diffuser **92** is shown attached to the soffit frame of the present invention. It should be noted, though, that an air diffuser is typically not installed until after the soffit panels underlying the soffit frame are installed. For this reason, as mentioned above, a preferred version of the inventive frame includes a coarse screen to prevent, for example, birds from penetrating the hollow connector (e.g., sufficiently far to set up a nest). A conduit **94** is shown attached to the upper portion of the hollow connector of the soffit frame of the present invention. Clearly a worker attaching the conduit to the soffit frame has better access to make the attachment (compared to a worker attaching a prior art soffit vent to a conduit pulled through the opening in an already-installed soffit), and to help ensure that the ventilation system generally is more effectively set up (e.g., by pulling any excess conduit, and trimming it to length, before attaching the conduit to the low-resistance, discharge-vent frame; also, by pulling the conduit to eliminate unnecessary or exaggerated bends—i.e., to minimize, to the extent possible, the tortuosity of the conduit and, therefore, the tortuosity of the air flow path). The remaining portion of the conduit preferably defines the straightest and shortest path possible to the ventilation fan, where the opposing end of the conduit is attached to the exhaust port of the ventilation fan. Accordingly, other versions of the inventive method include one or more of: installing a ventilation fan having an exhaust port; attaching a conduit to the exhaust port of the ventilation fan; attaching the opposing end of the conduit to the hollow connector.

[0062] FIG. **10** shows the installed low-resistance, discharge-vent soffit frame depicted in FIG. **9**, but with the soffit panels **94** installed (in FIG. **10**, lines are not drawn from each and every soffit panel to the number "**94**"). The air diffuser **92**, as explained above, preferably includes angled panels configured to direct air at an angle from an imaginary, vertical axis extending from the center of the diffuser to the ground below. This vertical axis is parallel to the building side **90**. When the air diffuser is attached to the soffit frame of the present invention, the diffuser is positioned so that air exhausted by the ventilation system is directed away from the side of the home to help minimize re-penetration of the discharged air back into the house. As noted above, installing non-vented soffit panels in the vicinity of the low-resistance, discharge-vent frame further inhibits re-penetration of exhausted air into the home. This is especially important when the exhausted air contains a significant amount of moisture.

[0063] It should be noted that the present invention is applicable to effecting whole-house ventilation. As mentioned above, whole-house ventilation systems are becoming more important as homes are made "tighter" (that is, less open to air exchange between the inside of the home and the outside environment; making homes "tighter" reduces the amount of energy needed to heat or cool the home, but increases the importance of achieving ventilation in some other manner, e.g., mechanically, using a ventilation system). As whole-house ventilation is emphasized, either in the marketplace, or by regulation (e.g., states mandating some metric corresponding to whole-house ventilation; such metrics are often first proposed by a standards-setting body), different solutions are and will be proposed. Surprisingly, a fan already installed in the home as a matter of course, a bathroom ventilation fan, may be used as the whole-house ventilation system. Bathroom ventilation fans, and systems, are typically used sporadically; i.e., for "spot" ventilation, when needed (e.g., when an occupant is taking a shower). Whole-house ventilation denotes continuous operation of the bathroom ventilation system to ventilate a building or house. Certain voluntary standards (now being adopted in a few states) provide recommendations on the volumetric air flow rate needed for whole-house ventilation as a function of building living area (e.g., in square footage), and the anticipated number of people who will reside in the building (when, of course, the building is a dwelling). By selecting a bathroom fan having a rated volumetric air flow rate (e.g., in cubic feet per minute) that exceeds, by some margin, the volumetric air flow rate recommended (or, as required, as standards are incorporated into state or local regulations) for whole-house ventilation, then an owner need not spend money on a separate system to achieve whole-house ventilation. Of course, as described in the present application, the bathroom ventilation system needs to be installed in a manner such that the measured volumetric air flow rate at fan intake (i.e., the vent through which air is discharged from the home) is as close as possible to the rated volumetric air flow rate of the installed ventilation fan. And, as described earlier, most ventilation systems in the field do not have measured discharge air flow rates that are close to the rated volumetric air flow rate of the corresponding bathroom fan. In fact, many are significantly lower than 80%. The present invention, however, addresses problems associated with the components of ventilation systems (primarily the prior art designs of soffit vents), and methods of installing these components of ventilation systems. As discussed elsewhere, problems with current ventilation systems include: the ventilation system as a whole is not planned; the individual components of the ventilation system are typically installed by different people, in part because current soffit vent designs cannot be installed at the same time the ventilation fan is installed—an installed soffit is required to attach the soffit vent, but the soffit is not in place when the house is first roughed in, the usual time at which a bathroom ventilation fan is installed; generally, no single person is accountable for the performance of the bathroom ventilation system as a whole; generally, current ventilation systems need only achieve some minimal threshold value, rather than some efficiency metric relating to the rated air flow rate of the ventilation fan; current soffit vent designs, and the corresponding methods of attaching these designs, limit access to the space above the vent, thereby limiting a worker's ability to ensure that the conduit is attached in an effective way—e.g., by pulling the conduit and trimming any excess length before attaching the conduit to the soffit vent; many current soffit vent designs provide significant resistance to air flow, either immediately upon installation because of their design, or because, over time, a fine screen becomes plugged with dust and debris; etc. The present invention helps address one or more of these problems, and therefore should lead to more effective ventilation systems that operate closer to the rated volumetric air flow rate of the corresponding fan. The present invention should help ventilation systems achieve 90%, or more of the bathroom fan's rated air flow rate. Accordingly, ventilation systems installed in accordance with the teachings of this application should allow for the planning, design, and installation of bathroom fans capable of effectively achieving whole-house ventilation.

[0064] The present invention also encompasses kits that include a ventilation fan, such as a bathroom ventilation fan or a kitchen ventilation fan, and a low-resistance, discharge-vent soffit frame. As noted above, bathroom ventilation systems are generally not carefully planned. Instead, components are chosen, and installed, in piecemeal fashion, often by different people. Kits that include both a ventilation fan and the low-resistance, discharge-vent soffit frame of the present invention will help ensure that the corresponding ventilation system includes the advantageous features described herein. Note, too, that while the present application primarily describes the invention in conjunction with bathroom ventilation systems, the low-resistance, discharge-vent frame may also be used with a kitchen ventilation fan.

[0065] It is to be understood that the embodiments of the invention herein described are merely illustrative of the application of the principles of the invention. Reference herein to details of the illustrated embodiments is not intended to limit the scope of the claims, which themselves recite those features regarded as essential to the invention.

EXAMPLE

Example 1

[0066] The air flow rates and efficiencies of a bench-scale ventilation system incorporating prior art soffit vents and a version of the low-resistance, discharge-vent, soffit frame were determined. A bathroom ventilation fan, model # FV-08VQ5, made by Panasonic, a business having offices in Secaucus, N.J., was used for all measurements. This particular ventilation fan has an HVI-certified (Home Ventilation Institute) rated air flow rate of 80 cubic feet per minute (cfm). Twelve and a half feet of flexible duct (i.e., conduit) having an inside diameter of 4 inches was connected to the exhaust port of the Panasonic ventilation fan. The first 11 feet of duct were pulled to be reasonably taut, and then the remaining 1.5 feet of duct was positioned at 90 degrees relative to the 11 foot portion of the duct (to simulate a 90 degree bend present in a home for that portion of the conduit that rises generally vertically from a soffit vent, and then proceeds generally horizontally toward the exhaust port of a bathroom fan). For each test, the fan was activated and the airflow determined without any soffit vent (identified as a "fitting" in the table below). The air flow was measured at the fan intake using a TSI Alnor LoFlo Balometer, available from TSI Alnor, a business having offices in Shoreview, Minn. The measurement without any soffit vent attached constituted the baseline airflow rate.

[0067] Each of the soffit vents to be tested was then attached, one at a time, to the end of the flexible duct. The fan was again activated and the airflow determined as before, with airflow now reflecting the effect of the attached soffit vent/fitting. The soffit vent identified as Fitting #1 was model #155W, available from Lambro, a business having offices in Amityville, N.Y. The soffit vent identified as Fitting #2 was model # A-400, available from Novik, a business having offices in St-Agustin-de-Desmaures, Quebec, Canada. The soffit vent identified as Fitting #3 was model # Intake Exhaust Vent 123 White, available from Mid-America Building Products, a business having offices in Wixom, Mich. The soffit vent identified as Fitting #4 was model # Soffit Exhaust Vent, available from Imperial Manufacturing, a business having offices in Richibucto, New Brunswick, Canada. The soffit vent identified as Fitting #5 was model # Soffit Exhaust Vent, available from Dundas & Jafine, a business having offices in Alden, N.Y. Each of Fitting numbers 1 through 5 are commercially available, prior art soffit vents. Fitting #6a is one version of the low-resistance, discharge-vent soffit frame of the present invention. This embodiment, structurally, is similar to the embodiment shown in FIGS. **1-3**. The upper portion of the hollow connector near the connector's intake opening has a circular cross section and an outside diameter of 4 inches (thus capable of insertion into the interior of the 4-inch duct). The lower portion of the hollow connector near the connector's output opening is 6 inches. In both cases the hollow connector included a one-quarter-inch hardware cloth (one-quarter inch denoting the approximate size of the openings), made with, for example, 23 gauge wire. Fitting #6a did not include an air diffuser fitted to the hollow connector. Fitting #6b did include a directional air diffuser inserted into the interior of the lower portion of the hollow connector. The directional air diffuser was similar to that shown in FIGS. **4** and **5** (note: the diffuser did not include a coarse screen, because one attached to the hollow connector). The diffuser included 5 angled panels, each panel having a thickness of about 3/16 inch, with each panel spaced about 1 inch from its neighbor. The panels were positioned within a circular opening having a diameter of about 5.5 inches. Each panel was at an angle of about 35 degrees from the vertical. The results for this bench-scale analysis are given in Table 1 below. The baseline air flow rate was determined

TABLE 1

Rated Fan flow = 80 cfm	*Baseline flow = 80 cfm	Tested flow =	% of Baseline flow =	% of Rated fan flow =
Fitting #1	80 cfm	65 cfm	81%	81%
Fitting #2	80 cfm	67 cfm	84%	84%
Fitting #3	80 cfm	65 cfm	81%	81%
Fitting #4	80 cfm	60 cfm	75%	75%
Fitting #5	80 cfm	51 cfm	64%	64%
Fitting #6a invention	80 cfm	80 cfm	100%	100%
Fitting #6b invention	80 cfm	80 cfm	100%	100%

to be 80 cubic feet per minute (cfm). In other words, the 12.5 feet of duct with a right-angle bend—and no fitting/soffit vent—did not result in a significant reduction in the fan's rated air flow. Accordingly, in this experiment, the measured baseline air flow rate for the experimental set up equaled the rated air flow rate of the fan. Each of the prior art soffit vents, when attached to the duct, significantly reduced the measured air flow. Each of the low-resistance, discharge-vent soffit frames of the present invention did not cause any reduction in measured air flow. Furthermore, the directional diffuser, when added to the inventive soffit frame, caused no additional reduction in the measured air flow.

Example 2

[0068] The procedure, apparatus, prior art soffit vents, and inventive soffit frames of Example 1 were used in a second experiment, except a ventilation fan having an HVI-certified rating of 110 cubic feet per minute (cfm) was used. This bathroom ventilation fan, model # FV-11VQ5, made by Panasonic, a business having offices in Secaucus, N.J., was used for all measurements. The results of this experiment are given in Table 2 below.

TABLE 2

Rated Fan flow = 110 cfm	*Baseline flow = 100 cfm	Tested flow =	% of Baseline flow =	% of Rated fan flow =
Fitting #1	100 cfm	76 cfm	69%	69%
Fitting #2	100 cfm	80 cfm	80%	73%
Fitting #3	100 cfm	79 cfm	79%	72%
Fitting #4	100 cfm	76 cfm	76%	69%
Fitting #5	100 cfm	67 cfm	67%	61%
Fitting #6a invention	100 cfm	103 cfm	103%	94%
Fitting #6b invention	100 cfm	100 cfm	100%	91%

The base line air flow rate was determined to be 100 cubic feet per minute (cfm). In other words, the presence of 12.5 feet of duct with a right-angle bend—without any fitting/soffit vent attached—resulted in a cfm reduction in airflow. Accordingly, in this experiment, the measured baseline air flow rate for the experimental set up was 10 cfm less than the rated air flow rate of the fan. Each of the prior art soffit vents, when attached to the duct, significantly reduced the measured air flow. Each of the low-resistance, discharge-vent soffit frames of the present invention did not appear to cause any reduction in the measured baseline air flow. Furthermore, the directional diffuser, when added to the inventive soffit frame, appeared to have only a small effect on air flow.

I claim:

1. A low-resistance, discharge-vent soffit frame comprising:

a hollow connector having an intake opening and an output opening,

a first adjustable member attached to the hollow connector, the first adjustable member having a first mounting element at one end of the first adjustable member and a second mounting element at the opposing end of the first adjustable member; and

a second adjustable member attached to the hollow connector, the second adjustable member having a first mounting element at one end of the second adjustable member and a second mounting element at the opposing end of the second adjustable member.

2. The low-resistance, discharge-vent soffit frame of claim **1** further comprising a screen interposed between the intake opening and the output opening.

3. The low-resistance, discharge-vent soffit frame of claim **1** further comprising a directional diffuser attached to the output opening of the hollow connector.

4. The low-resistance, discharge-vent soffit frame of claim **1** wherein the hollow connector includes a substantially horizontal portion.

5. The low-resistance, discharge-vent soffit frame of claim **4** further comprising a damper attached to the horizontal portion of the hollow connector and interposed between the intake opening and the output opening.

6. A bathroom ventilation system comprising:

a bathroom fan having an exhaust port;

the low-resistance, discharge-vent soffit frame of claim **1**; and

a conduit having two ends, wherein one end of the conduit is attached to the exhaust port of the bathroom fan, and wherein the opposing end of the conduit is attached to the intake opening of the low-resistance, discharge-vent soffit frame.

7. A kitchen ventilation system comprising:

a kitchen fan having an exhaust port;

the low-resistance, discharge-vent soffit frame of claim **1**; and

a conduit having two ends, wherein one end of the conduit is attached to the exhaust port of the kitchen fan, and wherein the opposing end of the conduit is attached to the intake opening of the low-resistance, discharge-vent soffit frame.

8. A bathroom ventilation kit, the kit comprising:

a bathroom ventilation fan; and

the low-resistance, discharge-vent soffit frame of claim **1**.

9. A kitchen ventilation kit, the kitchen ventilation kit comprising:

a kitchen ventilation fan; and

the low-resistance, discharge-vent soffit frame of claim **1**.

10. A method of installing a bathroom ventilation system in a building having both a bathroom and a roof that defines eaves extending from a building side, the method comprising the steps of:

providing a low-resistance, discharge-vent soffit frame comprising:

a hollow connector having an intake opening and an output opening,

a first adjustable member attached to the hollow connector, the first adjustable member having a first mounting element at one end of the first adjustable member and a second mounting element at the opposing end of the first adjustable member; and

a second adjustable member attached to the hollow connector, the second adjustable member having a first mounting element at one end of the second adjustable member and a second mounting element at the opposing end of the second adjustable member;

attaching the first mounting element of each adjustable member to a portion of the eaves; and

attaching the second mounting element of each adjustable member to the building side.

11. The method of claim **10** further comprising the step of installing a bathroom ventilation fan having an exhaust port, and wherein the bathroom ventilation fan has a rated air flow rate.

12. The method of claim **11** further comprising the steps of:

providing a conduit having two ends;

attaching one end of the conduit to the exhaust port of the bathroom ventilation fan; and

attaching the other, opposing end of the conduit to the intake opening of the hollow connector.

13. The method of claim **12** further comprising the step of installing one or more soffit panels defining a hole in fluid communication with the output opening of the connector.

14. The method of claim **13** wherein the soffit panels under the low-resistance, discharge-vent soffit frame are not vented.

15. The method of claim **14** further comprising the step of attaching an airflow diffuser over the hole defined by the one or more soffit panels.

16. The method of claim **15** wherein the airflow diffuser is configured to direct airflow substantially away from the soffit panels and the building side from which the eaves extend.

17. A whole-house ventilation system comprising the low-resistance, discharge-vent soffit frame of claim **1**.

18. The whole-house ventilation system of claim **17** further comprising a screen interposed between the intake opening and the output opening.

19. The whole-house ventilation system of claim **18** further comprising a directional diffuser attached to the output opening of the hollow connector.

20. The whole-house ventilation system of claim **19** further comprising a bathroom ventilation fan, wherein the bathroom ventilation fan is configured to operate both intermittently for spot ventilation and continuously for whole-house ventilation.

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