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Brinton et al.

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[54] **ACOUSTICAL VENTILATOR**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** ..... **98/42,** 98/66 R, 98/83, 181/50

[51] **Int. Cl.** **F24f 7/02**

[58] **Field of Search** ..... 98/42, 43, 83, 66 R; 181/33 G, 50

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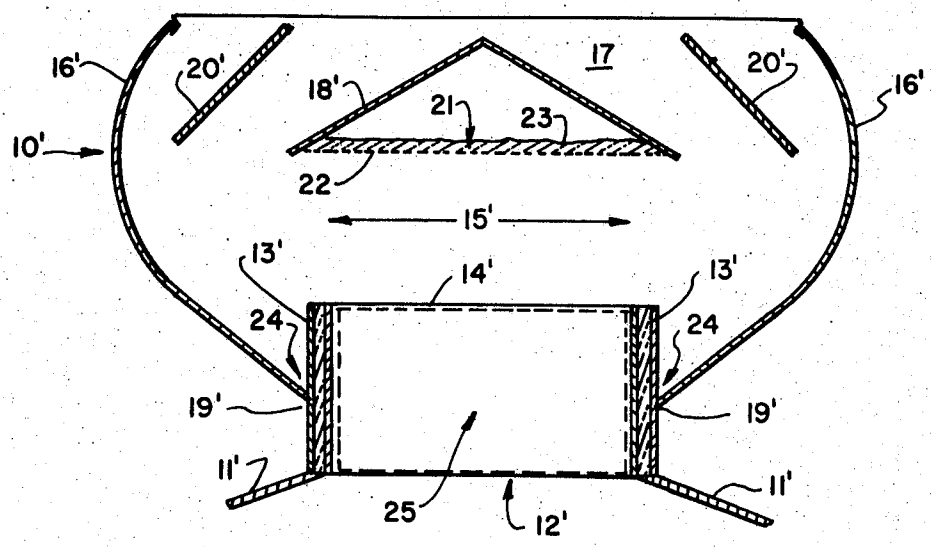
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[57] **ABSTRACT**

A ridge ventilator by which exhaust gases, smoke, fumes, dust and heat are discharged from the interior of buildings. The ridge ventilator is uniquely adapted to restrict the acoustical energy which is released from the ventilator without affecting the discharge gases through the ventilator.

4 Claims, 5 Drawing Figures



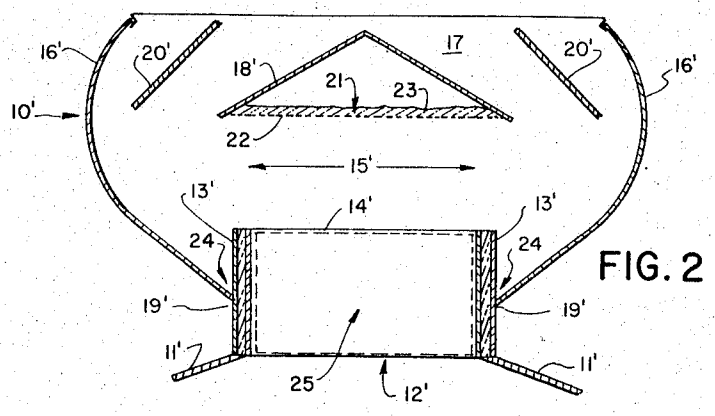


FIG. 2

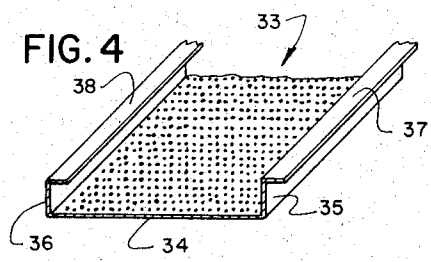


FIG. 4

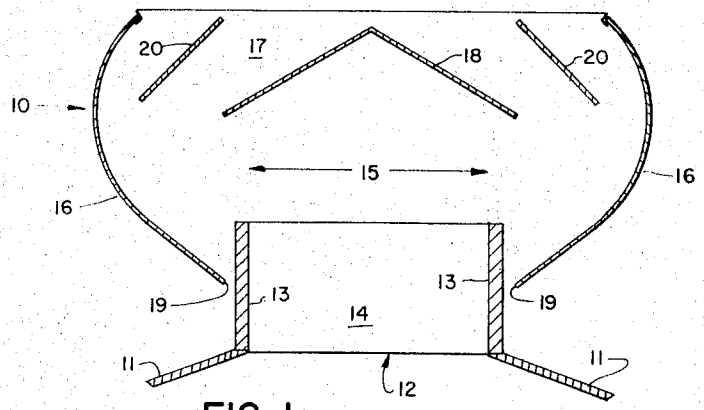


FIG. 1
PRIOR ART

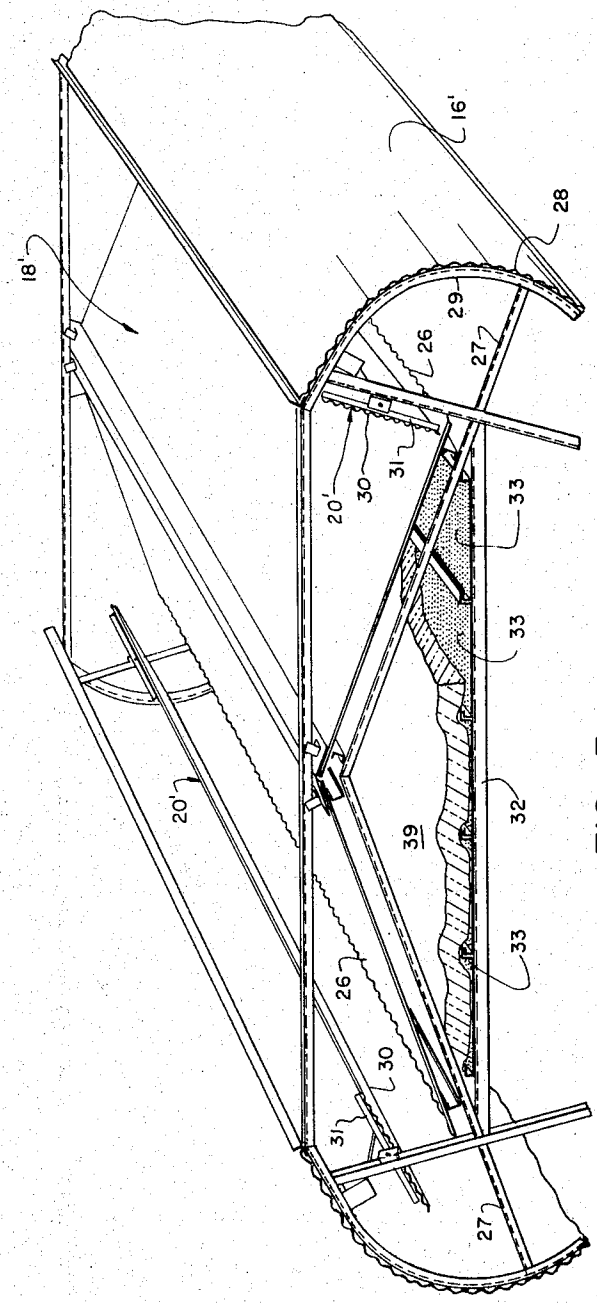


FIG. 3

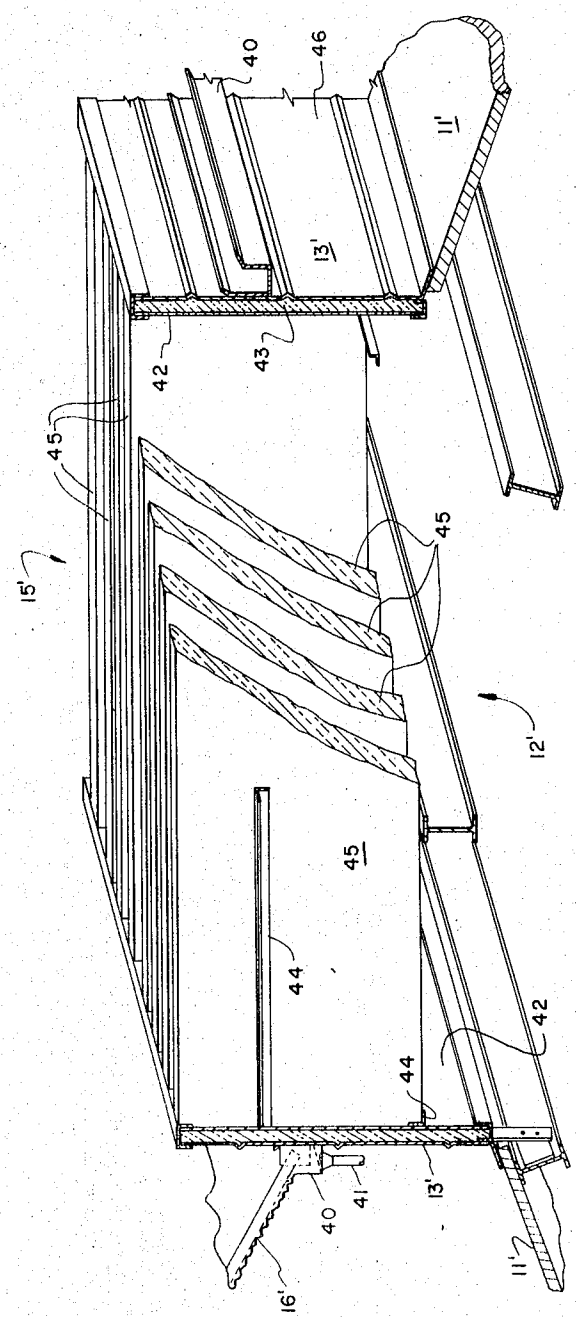


FIG. 5

ACOUSTICAL VENTILATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention concerns a building ventilator of the type known as a ridge ventilator, and more particularly a ridge ventilator having improved acoustical properties.

2. Description of the Prior Art

Ridge ventilators have been a standard construction in the building industry for many years. In general they consist of an appropriately weather-shielded, horizontal, rectangular opening in the roof of a building. While the building may have an essentially flat roof, customarily such ventilators are employed in ridged or pitched roofs and the ventilator is provided at the apex of such roofs. Exhaust gases, smoke, fumes, dust and heat are discharged from the interior of buildings through such ridge ventilators most effectively when they are positioned at the apex of the building roof. The weatherproofing features are designed to preclude entry of atmospheric precipitation without presenting significant obstructions to the free flow of discharging gases. Good aerodynamic design of the shapes of the weatherproofing features will improve the discharging characteristics of such ridge ventilators.

SUMMARY OF THE INVENTION

Recently laws have been promulgated to regulate the amount of acoustical energy which can be released from a building to its surrounding areas. Some acoustical energy is released through walls and windows of buildings, some through the roofs of buildings and a surprising amount through the open ridge ventilators of buildings. The present invention provides a ridge ventilator which is uniquely adapted to restrict the acoustical energy which is released from the ventilator without seriously affecting the discharge gases through the ventilator. In accordance with the present invention, the otherwise conventional ridge ventilator is equipped with:

A. acoustically reflecting curb members at the throat of the ventilator;

B. an acoustically absorbant surface disposed beneath the cap of the ridge ventilator in confronting relation with the open throat of the ventilator;

C. if desired, supplemental acoustical absorbing panels disposed transversely across the throat of the ventilator;

D. a substantially imperforate connection between the ventilator cowling and the ventilator curb. Buildings equipped with the present improved ridge ventilator have significantly lowered acoustical sound release characteristic.

Because of release of acoustical energy from a building accurs through a variety of routes, the present improved acoustical ventilator will not provide noticeable improvement in the performance of a building which is readily sound transmissive through its walls or roofs or windows. However for a building having suitably acoustically non-transmissive walls, windows and roofs, the improved acoustical ventilator of this invention is effective.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional illustration of a conventional ridge ventilator which is known in the prior art.

FIG. 2 is a cross-sectional illustration similar to FIG. 1 of a ridge ventilator according to the present invention with certain parts shown in phantom outline.

FIG. 3 is an exploded view of a typical ridge ventilator according to the present invention illustrating the relation of various components in more detail.

FIG. 4 is a perspective fragmentary illustration of a typical perforated sheet metal panel useful in the ridge ventilator of FIG. 3.

FIG. 5 is a fragmentary perspective illustration of a throat of the present acoustical ventilator showing an additional embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Prior Art

Referring to FIG. 1, a typical ridge ventilator **10** is mounted on a pitched roof **11** above a roof opening **12** which is generally horizontal and generally rectangular in plan. The roof opening **12** is bordered by curb members including side walls **13** and end walls **14** which define the ventilator throat **15.**

The ventilator cowling consists of curved sheeting **16** and flat end walls **17.** A ridged cap member **18** has a width greater than the ventilator throat **15** and is disposed in confronting relation to the ventilator throat **15.** The curved sheeting **16** and end walls **17** are supported by suitable structural members (usually steel angles or channels) which are not shown in FIG. **1.** It will be observed that the bottom ends **19** of the curved sheeting **16** are spaced-apart from the side walls **13** so that any atmospheric precipitation can pass between the bottom ends **19** and the side walls **13** and thence flow downwardly over the pitched roof **11.** Frequently air-flow guide vanes **20** are provided between the curved sheeting **16** and the ridged cap member **18** to minimize turbulence within the ventilator **10** and also to interrupt the straight line flow of atmospheric precipitation and thereby prevent ingress through the ventilator throat **15** to the interior of the building. The ridged cap member **18** and the vanes **20** also are supported by means of suitable structural members which do not appear in FIG. **1.**

The sheeting **16** may be angled (U.S. Pat. No. 2,127,099 — WHITAKER 1938) or curved (U.S. Pat. No. 2,232,027 — GUNTER 1941 and 2,404,961 — HOCH 1946) although the curved shape is preferred for economy of sheet metal and for minimizing pockets of air turbulence within the ventilator **10.** The sheeting **16** preferably is sheet metal which may be flat, slightly corrugated or embossed.

The Present Invention

The improved acoustical ventilator of the present invention is illustrated in FIG. **2** which is a cross-section illustration similar to FIG. **1** wherein corresponding numerals are employed to identify corresponding parts. The ventilator of FIG. **2** identified by the numeral **10'** is mounted on a pitched roof **11'** having a roof opening **12'.** The installation includes a generally vertical stack including generally vertical side stack walls **13'** and generally vertical end stack walls **14'** which define a ventilator throat **15'.** The superstructure includes curved sheeting **16',** flat end walls **17',** a ridged cap member **18'** and air flow directing vanes **20'.** The air flow directing vanes **20'** may be fixed or, preferably,

may be pivotally mounted to permit them to serve as dampers as will be illustrated hereinafter.

Alterations to the Ridged Cap Member

The ridged cap member **18'** is provided with acoustical absorbing surface identified generally by the numeral **21.** The usrface **21** extends across its undersurface of the ridged cap member **18'** in direct confrontation with the ventilator throat **15'.** Preferably the acoustical absorbing surface **21** consists of a perforated rigid plate **22** and a layer **23** of fibrous sound absorbing material. The perforated rigid plate **22** is preferably sheet metal. The sound absorbing layer **23** is preferably mineral wool or glass fibers which will resist elevated temperatures.

Alterations to the Ventilator Stack

The side walls **13'** and end walls **14'** have an inner surface of sound reflecting material such as imperforate sheet metal panels in order to confine the acoustical energy from dissipation outwardly through the walls **13', 14'** and further to channelize the acoustical energy into impingement against the sound absorbing surface **21.** The structure of the walls **13', 15'** will be more fully described in relation to the discussion of FIG. **5.**

The two revisions just described will collectively accomplish the significant reduction in the sound released from the building. In addition to these two revisions, several further improvements have been incorporated in the ventilator of FIG. **2.**

Specifically the bottom ends **19'** of the curved sheeting **16'** are contiguous with the outer surface of the side walls **13'** so that no gap is presented for the dissipation of acoustical energy. Suitable guttering, discussed supra in relation to FIG. **5,** is provided in the region **24** to discharge any accumulations of atmospheric precipitation.

As a still further improvement, one or more panels **25** of acoustically absorbant material may be inserted transversely into the ventilator stack generally parallel to the end walls **14'** and normal to the side walls **13'.** Lightweight metal frames for holding the acoustical panels **25** may be provided to permit removal of the acoustical panels **25** for cleaning and/or replacement from time to time without requiring dismantling of the ventilator **10'.** The acoustically absorbant panels **25** preferably are formed from fibrous incombustible materials such a mineral wool or glass wool.

The presence of acoustical panels **25** reduces the available cross-sectional free area in the ventilator throat for flow of discharging gases. Accordingly when the acoustical panels **25** are employed, the cross-sectional area of the ventilator throat **15'** must be increased if the exhausting capacity of the ventilator is to be equivalent to that of a similar ventilator without such acoustical absorbing panels **25.** The increase in size can be accomplished by increasing the width of the ventilator throat **15'** — that is, by increasing the size of the end walls **14'** — or by increasing the length of the ventilator — that is, by increasing the length of the side walls **13',** curved sheeting **16',** ridge cap member **18'** and guiding vanes **20'.**

As a general matter, it is impractical to increase the length of a ventilator because ventilation effectiveness depends upon locating the ventilator directly above the heat source within a building. Accordingly it is preferred to increase the width of the ventilator. At the outset, i.e., during design and construction, utilization of transverse acoustical panels **25** should be anticipated. Accordingly the width of the ventilator throat should be increased about 40 per cent so that the total exhaust cross-sectional area of the throat is about 40 per cent in excess of the anticipated unobstructed throat requirement. The design of the ventilator is such that the required number of acoustical panels **25** can be introduced at any time after the building is completed to satisfy the acoustical requirements. The 40 per cent increase which is recommended will permit subsequent introduction of a multitude of acoustical panels **25.** For example, panels having a thickness of 100 millimeters can be spaced 150 millimeters apart without interfering with the required exhaust cross-sectional area if the prescribed **40** per cent width increase is provided.

Referring to FIG. **3,** a perspective illustration of a fragment of the improved ventilator is illustrated. It will be observed that the ridged cap member **18'** has a covering of corrugated sheet metal **26** supported on sloping structural members **27.** The curved sheeting **16'** has corrugated sheet metal **28** mounted on suitably curved frame members **29.** The guiding vanes **20'** consist of corrugated sheet metal **30** mounted on a suitably pivotal frame **31.** It will be observed that the left-hand vane **20'** is shown in a full-open position whereas the right-hand vane **20'** is shown in a pivoted position wherein it functions to close the exhaust passageway. Beneath the ridged cap member **18** is a generally horizontal frame member **32** to which perforated sheet metal channel sections **33** are secured. A fragment of a typical sheet metal channel section **33** is illustrated for clarity in FIG. **4.** The section **33** includes a web **34,** upwardly extending side walls **35, 36,** and terminal flanges **37, 38** both extending in the same direction. The web **34** preferably is perforated with holes which may be uniformly dispersed in a regular pattern or which may be provided in a random pattern. The perforations in the web **34** may be of identical size, of several sizes, or may be of randomly selected sizes.

The total perforated area should be at least 25 per cent of the area of the web **34** so that the webs **34** can be considered to be sound-transparent.

Typically the sheet metal section **33** is fabricated from light gauge steel, 26 through 14 gauge. The web **34** may range in width from about 25 to 100 centimeters. The side walls **35, 36** may range from about 1 to 10 centimeters. The vertical side wall **36** should be one metal thickness shorter than the vertical side wall **35** in order that the flange **37** of one section can overlap a corresponding flange **38** of the adjacent and abutting section.

Reverting to FIG. **3,** the assembled channel sections **33** are covered with a layer **39** of sound absorbing materials such as mineral wool or glass fibers. The layer **39** has a thickness from 2 to 20 centimeters and is coextensive with the assembly of channel sections **33.** Preferably a glass fiber veil, essentially sound-transparent, is applied on top of the channel sections **33** to serve as a restraining net which will prevent the lose mineral wool from falling through the perforations.

Referring to FIG. **5** there is illustrated a fragmentary view of the ventilator throat showing the roof **11',** the roof opening **12',** the side walls **13',** a curved sheeting **16'** and a ventilator throat **15'.**

It will be observed that a sheet metal gutter **40** is secured to the outer surface of the side walls **13'** and that a gap-free connection is presented between the outer wall of the side wall **13'** and the curved sheeting **16'.**

Suitable discharge conduits **41** are presented to release accumulated atmospheric condensation.

The inner surface **42** of the side walls **13'** is fabricated from a sound reflecting material such as imperforate sheet metal. The interior of the side walls **13'** is filled with insulating material **43** to minimize transmission of sound energy through the side walls **13'**. The insulating material **43** may be mineral wool or glass fibers.

The inner sheet **42** preferably is formed from sheet metal which has a different thickness than the sheet metal of the outer sheet **46.** The spacing between inner sheet **42** and outer sheet **46** is preferably about 75 millimeters. The insulating material **43** preferably has a density of about 70 kilograms per cubic meter.

The height of the side walls **13'** is greater than the height of the acoustical panels **45.**

Also seen in FIG. **5** is a frame member **44** extending transversely across the ventilator throat **15'** between the side walls **13'** for supporting generally rectangular, vertically presented, sound absorbing panels **45.** Four such sound absorbing panels **45** are illustrated in partly-cut-away presentation in FIG. **5.** Each one is individually mounted in a suitable frame **44** in such manner that the panel **45** can be removed and replaced easily without dismantling the ventilator superstructure.

It should be emphasized that the present ventilator improvement is effective regardless of whether the sound absorbing panels **45** are employed. Their use will provide further acoustical improvement where such refinements are required. The ventilator has a further advantage that its initial erection is achieved by workmen on the roof. No interior construction is required. The entire ventilator assembly is essentially above the roof level without any intrusions into the building space.

Typical existing regulations establish allowable acoustical levels for various zones in terms of maximum noise. The noise is measured in decibels on the "A" network, referred to as db(A). The maximum levels are set forth in the following table;

	Type of Activity	Maximum Noise Level db(A)
1.	Industrial Zone	70
2.	Mixed Zone,	65 (day)
	Mainly Industrial	50 (night)
3.	Mixed Zone,	
	Equally Divided between	60 (day)
	Industry & Private Dwellings	45 (night)
4.	Mixed Zone,	55 (day)
	Mainly Residential	40 (night)
5.	Residential Zone	50 (day)
		35 (night)
6.	Quiet Zone,	45 (day)
	For Example, Hospitals	35 (night)

These noise levels do not apply to the noise level at the source but, in general, are the maximum allowable values at a point which is 1 meter in front of the nearest private dwelling. The noise levels are considered as average values over a period of time but some regulations include additional stipulations concerning the type of noise, the frequency, the maximum intensity, et cetera.

Employing the principles set forth in the present application under actual tests, sound intensities were measured at 10 meters from the ventilator in two directions. The first direction was 90° from the ventilator axis; the second direction was in line with the ventilator axis. The sound reduction measured at 10 meters (90° from the ventilator axis) was 25 decibels. The sound reduction measured 10 meters (in line with the ventilator axis) was 37 decibels. More detailed sound intensity measurements indicated that sound reductions were achieved at all frequencies normally associated with audible sound.

We claim:

1. In a ridge ventilator which surmounts a generally rectangular and horizontal opening in the roof of a building, a generally vertical stack including generally vertical side stack walls and generally vertical end stack walls which are connected to each other and which form an open box-like enclosure partly above the said opening, said ventilator including side walls extended outwardly and upwardly from said stack generally parallel with the long edge of the opening and having end walls connected to the side walls and extending upwardly from the narrow edge of the opening, and having a cap member disposed above the opening between the side walls and extending substantially entirely between the end walls, the improvement comprising: an acoustic absorption assembly applied to the undersurface of the said cap member in confrontation with said opening, said assembly including a plurality of perforate rigid, sheets confronting said opening and a layer of absorbent for acoustical energy supported between the cap member and the sheets; and each of the end and side stack walls comprising an exterior sheet, an imperforate interior sheet, and an insulating material filling the space therebetween, thereby to minimize transmission of sound energy through the end and side stack walls, the imperforate inner sheet of the end and side stack walls providing imperforate inner surfaces having reflecting properties for acoustical energy, the imperforate inner surfaces channelizing acoustical energy received from the building interior into impingement against said acoustic absorption assembly.

2. The ridge ventilator of claim **1** including at least one frame extending from one stack side wall across the said opening to the other stack side wall, and a sound absorbing panel supported by the said frame.

3. The ridge ventilator of claim **2** wherein the ventilator side walls are connected to the stack side walls by an imperforate connection thereby to provide a gutter for draining condensation which accumulates between the inner surface of the ventilator side wall and the outer surface of the stack side wall.

4. The ridge ventilator of claim **2** wherein the thickness of the exterior sheet is different from that of the imperforate interior sheet.

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