April 26, 1966 C. F. JUENG 3,247,775

COMPOSITE GRAVITY VENTILATOR

Filed March 19, 1965

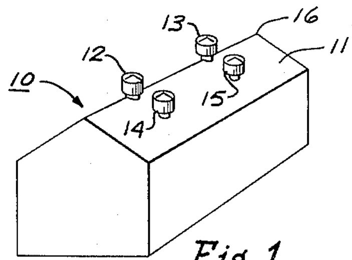

Fig. 1

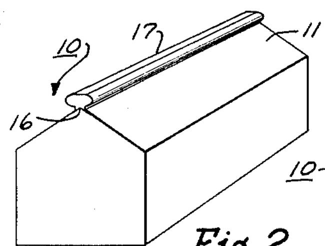

Fig. 2

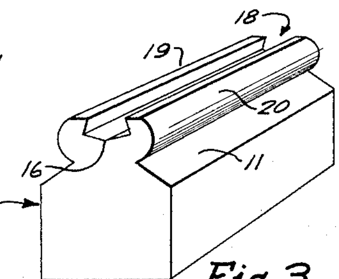

Fig. 3

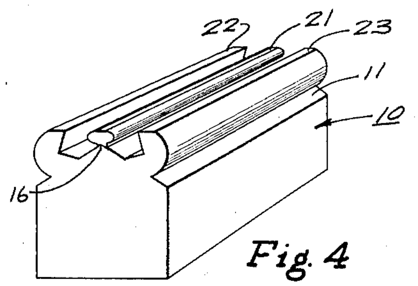

Fig. 4

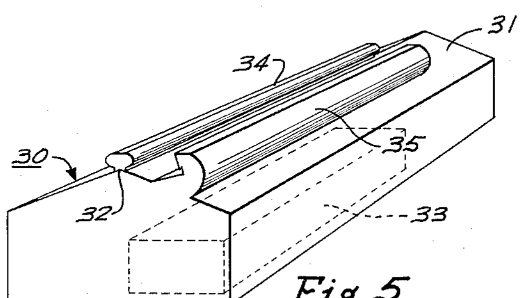

Fig. 5

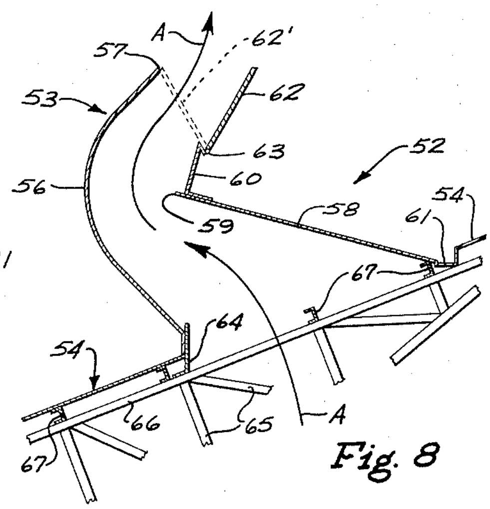

Fig. 8

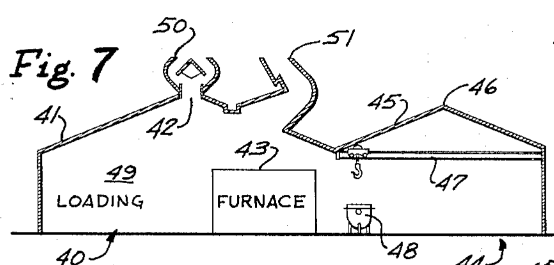

Fig. 7

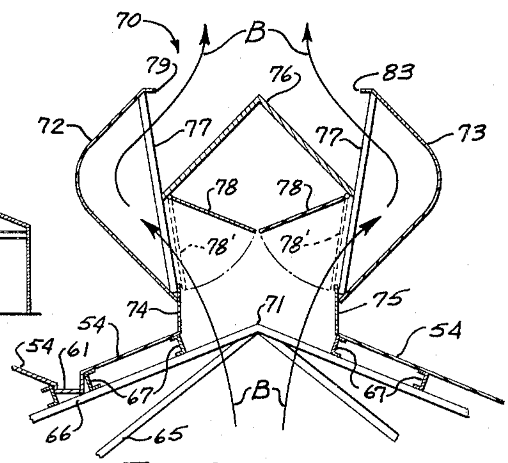

Fig. 9

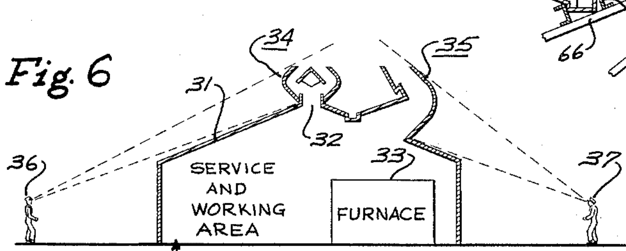

Fig. 6

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3,247,775
COMPOSITE GRAVITY VENTILATOR

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1 Claim. (Cl. 98—42)

This application is a continuation-in-part of my co-pending application Serial No. 317,979 filed October 22, 1963, now U.S. Patent 3,182,580, which in turn is a continuation-in-part of my former application Serial No. 109,573, filed May 12, 1961, now abandoned.

This invention relates to a composite ventilator construction including the unlikely combination of a ridge ventilator and one half of a monitor ventilator. The composite ventilator of this invention is peculiarly adapted for exhausting large quantities of heated gases from the interior of a building having a pitched roof with a central ridge and having a heat source such as a furnace disposed within the building off center with respect to the central ridge. Furnace buildings in the glass and steel industry are constructed in this manner from time-to-time.

The ventilation of such buildings requires the rapid removal of large quanties of heated gases. This gas removal is most economically accomplished by the use of large natural draft roof ventilators which are sometimes called "gravity ventilators" to indicate that no fans or blowers are required in the ventilator. The ventilating opening in the roof of the building is dimensioned in direct proportion to the amount of gas that is exhausted. Thus a large quantity of gas requires a large roof opening which in turn requires a large ventilator. Besides functioning as a device for exhausting hot air, the roof ventilator must also prevent the ingress of precipitation and atmospheric debris and also prevent reverse flow of air due to wind currents.

The present invention, its objects and advantages, will be more fully described in the following detailed description by reference to the accompanying drawings in which:

FIGURES 1, 2, 3 and 4 are schematic perspective sketches of pitched roof industrial buildings utilizing the ventilating schemes of the prior art;

FIGURE 5 is a schematic perspective illustration of a pitched roof industrial building utilizing the present ventilator scheme;

FIGURE 6 is a cross-section sketch taken through the center of the building of FIGURE 5;

FIGURE 7 is a cross-section sketch of a typical industrial building arrangement of industrial furnace buildings;

FIGURE 8 is a cross-section view taken through a typical one-half of a monitor ventilator; and

FIGURE 9 is a cross-section view taken through a typical ridge ventilator.

Prior art

Typical gravity ventilators of the prior art are illustrated in FIGURES 1, 2, 3 and 4. Where relatively small quantities of heated gases are discharged to the atmosphere, one or more round cross-section gravity ventilators is mounted on the roof of the industrial building. In FIGURE 1, a building **10** is shown having a pitched roof **11** with four round cross-section gravity ventilators **12, 13, 14, 15** mounted thereon. Such ventilators are prominent in the industrial landscape and are described, for example, in U.S. Patents 1,589,581 and 2,739,520. Such ventilators may be positioned along the ridge **16** of the building **10**, as the ventilators **12, 13**, or along the sloping roof **11**, such as the ventilators **14, 15**.

Where larger quantites of heated gases are generated within the industrial building, a ridge ventilator **17** may be mounted along the ridge **16** of the building **10** shown

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in FIGURE 2. Such ridge ventilators are described, for example, in U.S. Patent 2,232,027.

The monitor ventilator, shown in FIGURE 3, was developed to handle enormous quanties of hot gases generated within industrial buildings. The building **10** of FIGURE 3 has a monitor ventilator **18** mounted on the roof **11**. The monitor ventilator **18** includes two monitor ventilator half portions **19, 20** on the opposite sides of the ridge **16**. Typical monitor ventilators are illustrated in Sweet's Industrial Catalog, 1965, section 15a/Ro and in Sweet's Architectural Catalog, 1965, section 20c/Bu.

According to my co-pending patent application Serial No. 317,979, a great improvement can be achieved in industrial ventilation by combining the ridge ventilator of FIGURE 2 with the monitor ventilator of FIGURE 3 to produce the composite ventilating apparatus shown in FIGURE 4.

Referring to FIGURE 4, the building **10** has a pitched roof **11** and central ridge **16**. A ridge ventilator **21** is mounted along the ridge **16** and a monitor ventilator is mounted on the pitched roof **11** having its two monitor ventilator half portions **22, 23** laterally displaced from the ridge ventilator **21**. The upper rims of the ridge ventilator **21** and the monitor ventilator half portions **22, 23** are maintained at the same elevation in order to avoid back draft from one unit to another. The composite roof ventilator arrangement of FIGURE 4 will permit discharge into the atmosphere of great quantities of heated gases. The overall height of the ventilators in FIGURE 4 above the ridge **16** is substantially less than the height of a single ridge ventilator or a monitor ventilator of sufficient size to accommodate the required ventilation capacity.

The size of ridge ventilators and monitor ventilators has a practical maximum limit of about 15 feet throat dimension. The superstructure required for buildings having ventilators of 15 feet throat dimension and greater is excessive. Such large structures present substantial exposed areas which must be supported to resist wind loads. The very size and the required support necessitates heavy duty structural members in the building which adds to the weight and cost of the building. Moreover unduly large ventilator structures are not aesthetically attractive. In general low silhouette buildings are desired in modern industrial plants.

Modern industrial buildings frequently release enormous quantities of hot gases from the apparatus therein contained in. Outstanding examples are glass melting furnaces and steel reheat furnaces. Such apparatus is confined within industrial buildings and requires extensive areas under roof for auxiliary service equipment and operating space for the working personnel. Because of the large auxiliary space required, these high heat sources (furnaces and the like) are desirably located off center within the building, that is, off center with respect to a central salient ridge of the building roof. Such disposition provides available working space in the remainder of the building and also locates the high heat source activity adjacent to one of the outside walls of the building to permit introduction of raw materials and removal of products from the furnace or similar high heat activity with a unidirectional materials movement.

The problem

In order to accommodate such modern industrial buildings having a high heat source disposed off center with respect to the building roof, conventional ventilating schemes have proved inadequate. Such installations release gases in such quantities that round cross-section gravity ventilators could not provide sufficient ventilation capacity even if the entire building roof were covered with them in a region above the high heat source. These high heat sources moreover generate exhaust gases at a rate far in excess of the capacity of the practical size ridge ventilators, which, as hereinabove mentioned, is about 15 feet in throat dimension.

Moreover the use of a ridge ventilator in such industrial buildings (having the high source off center with respect to the central salient ridge) requires extensive lateral transfer of the exhaust gases from the heat source to the roof outlet with accompanying (a) deterioration of the roof structure above the heat source and (b) dissemination of the fumes and gasborne particles into otherwise uncontaminated regions of the building.

A monitor ventilator cannot provide the necessary ventilation. It would be possible, of course, for one half of the monitor ventilator to be located directly above the high heat source whereby the fumes and exhaust gases may be delivered directly overhead from the high heat source without accompanying roof deterioration or dissemination of the exhaust gases throughout the interior of the building. However, the other half of the monitor ventilator—located opposite the high heat source—would be essentially useless since there is no corresponding high heat source located beneath that other half. Moreover the useless half of the monitor ventilator would in fact be detrimental since there would be a great tendency for atmospheric air to flow into the interior of the building through the inactive monitor ventilator, perhaps bringing with it gases and fumes which were previously discharged from the operative half of the monitor ventilator. It would be prodigal, of course, to construct the second half of the monitor ventilator and then to seal that half of the monitor ventilator to prevent the undesirable ingress of atmospheric air.

A further attempted solution to the problem calls for the construction of a nonsymmetrical pitched roof having two sloping surfaces of different acclivity whereby the salient ridge is located directly above the high heat source. That proposal would permit the construction of a ridge ventilator directly above the high heat source or alternatively the construction of a monitor ventilator which could service the high heat source. This proposal has been totally discredited for two reasons: (a) The added structural expense for construction of a nonsymmetrical pitched roof is excessive; (b) The building frequently is required to fit into and correspond with a number of other industrial buildings in the same plot of ground. A skewed roof construction on one building would be aesthetically undesirable alongside a conventional pitched roof building of symmetrical configuration.

The present invention

According to the present invention I provide in a building having a pitched roof and a source of high heat release off center from the central salient ridge, a combination of a ridge ventilator and one half of a monitor ventilator to satisfy the ventilation exhaust requirements of the building.

The present invention is illustrated in FIGURE 5 wherein the building 30 is provided with a pitched roof 31 having a salient ridge 32. A source of high heat release such as a furnace 33 is located within the building 30 off to one side of the salient ridge 32. A ridge ventilator 34 extends along the salient ridge 32 of the building and communicates with the interior of the building 30 to allow for the vertically upward discharge of gases and fumes. One half of a monitor ventilator 35 is provided on the sloped roof 31 above the furnace 33. The upper rims of the ridge ventilator 34 and the half of the monitor ventilator 35 are maintained at the same elevation to minimize cross-flow of gases between the two outlets.

While the present ventilator arrangement as seen in FIGURE 5 is unbalanced and is nonsymmetrical in cross-section and therefore appears to be an undesirable construction, nevertheless I have made a remarkable discovery which is illustrated in FIGURE 6.

The building 30 contains a high heat source such as furnace 33 on one side of the salient ridge 32 and the remainder of the building 30 constitutes an extensive servicing and working area having minimal ventilation requirements. With the ridge ventilator 34 and the one-half monitor ventilator 35, the building 30 appears in cross-section, to be unbalanced. However, a viewer (indicated by the human figure 36) outside the building 30 sees only the ridge ventilator 34. Similarly a viewer (indicated by the human figure 37) on the other side of the building 30 sees only the one-half monitor ventilator 35. Thus, in actual practice, the obviously unbalanced building arrangement shown in FIGURE 6 cannot be reasonably detected by visual inspection. The viewer located at 36 could not distinguish by visual inspection alone the buildings of FIGURE 2, FIGURE 5 or FIGURE 6. Similarly, the viewer located at 37 could not distinguish by visual inspection alone the building shown in FIGURES 3, 4, 5 and 6.

Thus, my discovery is that since ventilation engineers and designers are accustomed to thinking of building arrangements by cross-sectional representations of the ventilation schemes, they have heretofore dismissed summarily any nonsymmetrical ventilation arrangements. I have found that a nonsymmetrical arrangement as shown in FIGURES 5 and 6 is completely functional in industrial buildings having a high heat source located off center with respect to the salient ridge and, quite unexpectedly, that the nonsymmetry of such structures exists only in the cross-sectional views and is not necessarily apparent in a three-dimensional embodiment of such nonsymmetrical ventilation arrangements.

Referring to FIGURE 7 there is illustrated a further industrial building having the present ventilation arrangement. The building 40 has a pitched roof 41 and the salient ridge 42. A source of high heat release such as a furnace 43 is disposed within the building 40 off center with respect to the salient ridge 42. A second building 44 with a pitched roof 45 and salient ridge 46 is located aside the original building 40 to present auxiliary services and to allow unidirectional movement of raw materials and products through the furnace 43. The building 44, for example, might contain an overhead crane 47 to collect heated products 48 from the furnace 43 for subsequent hot processing. A loading aisle 49 within the building 40 provides ingress for the raw materials which are heated in the furnace 43 and provides space for supervision, servicing and maintenance 43. The hot gases from the furnace 43 can be discharged in parallel flow paths vertically upwardly through the ridge ventilator 50 and the one-half monitor ventilator 51 which are mounted on the roof 41 and which have their upper rims at substantially the same elevation.

In FIGURE 8 there is more fully illustrated a half of a monitor ventilator 52 which comprises a clam shell element 53 mounted on a sloped roof surface 54. The clam shell element 53 is thereby in communicating relation with the interior of the building for exhausting gases therefrom as illustrated by the arrows marked A. The clam shell element 53 comprises a cowling sheet element 56 having an upper rim 57 and a sloping wall surface 58 which terminates in a wall surface edge 59 whence an inner wall 60 rises. A rain gutter 61 is provided at the inboard end of the sloping wall surface 58. A pivotal damper 62 is pivotally secured to the inner wall 60 by means of a hinge 63. The damper 62 is shown in its fully open position in solid lines and is shown in its fully closed position in phantom outline (62′). The clam shell element 53 further includes a curb wall 64 which is attached to the sloped roof surface 54. The outer cowl 56 is attached at its lower end to the curb wall 64. The struts 65, 66 comprise the superstructure or roof truss of the building and support the roof surface 54. Channels 67 may be provided as purlins to support the actual roof surface 54 and the ventilator 52.

In FIGURE 9, a ridge ventilator 70 is more fully illustrated. The ridge ventilator 70 comprises a pair of spaced-apart side walls 72, 73 each attached at the lower end thereof to a curb wall 74, 75 respectively and terminating in upper rims 79, 83 respectively. The curb wall 74 communicates with and is an extension of the roof surface 54. The curb wall 75 likewise communicates with and is an extension of the roof surface 54. Internally the ridge ventilator 70 has a cap member 76 in the form of a V-shaped deflector which is supported in the inverted-V position to divert entrant precipitation and atmospheric debris laterally. It will be observed that the cap member 76 is wider than the throat of the ridge ventilator, i.e., wider than the distance between the tops of the curb walls 74, 75 which comprise the ridge ventilator opening of the roof 54. Internal struts 77 within the ridge ventilator 70 connect component elements and provide the necessary rigidity and strength to resist wind forces which will be developed.

A pivotal damper 78 is pivotally mounted at each lateral edge of the cap member 76. The dampers 78 are shown in their full open position. In phantom outline in FIGURE 9, the pivotal dampers 78' appear in their fully closed position. The struts 65, 66 comprise the superstructure or roof truss of the building and support the roof surface 54. Channels 67 may be secured to the struts 66 to support the roof surface 54 and the ventilator 70.

The ridge ventilator 70 is mounted centrally over the salient ridge 71 in communicating relation with the interior of the building for exhausting gases therefrom as illustrated by the arrows labeled B.

The specific construction of ridge ventilator 70 or of the monitor ventilator 52 forms no part of my present invention. Numerous ridge ventilators have heretofore been installed throughout the country. Likewise, numerous monitor ventilators have been installed throughout the country. My present invention, concerns the combination of one-half of a monitor ventilator with a ridge ventilator in cooperating relation for the common ventilation of a single building.

I am aware that the concept of installing of one-half of a monitor ventilator by itself is not novel since such structures have been utilized in the past as the standard ventilation arrangement for aluminum pot houses. In such prior installations, however, the building roof has required separate and different pitches from the building sides upwardly toward the centrally disposed monitor half ventilator.

In general, all ridge ventilators have certain common features. They are mounted on the roof of a building, extend along a central salient ridge and have opposed side walls which are disposed parallel to each other. The side walls extend from (a) their base which is adjacent to the lateral edges of a central horizontal ventilator opening in the roof upwardly and outboard of the said central horizontal opening to (b) an upper rim. The ridge ventilators moreover have a cap member which is disposed between and apart from the side walls and above the central horizontal openings whereby the ridge ventilators have a pair of parallel gas passageways, each located between the lateral edge of the cap member and one of the side walls.

In general half-portions of monitor ventilators have certain common features. These half monitor ventilators are provided above the roof of the building in relation to a lateral outwardly presented vertical ventilator opening. The building roof adjacent to the half-monitor ventilator has a raised portion on one side of the salient ridge which cooperates with the remainder of the sloping roof to define the vertical ventilator opening. The half of the monitor ventilator further includes a cowling sheet element which is parallel with the salient ridge and includes a damper means. The cowling sheet element extends (a) from its base at the building roof below the bottom edge of the vertical opening upwardly outboard of the vertical opening (b) to an upper rim which is disposed above the vertical opening so as to prevent straight line entry of precipitation into the interior of the building. A damper means is disposed between the cowling sheet element and the raised portion of the roof for controllably obstructing the gas passageway between the cowling sheet element and the roof.

I claim:

In a building having a pitched roof with a central ridge and having an interior heat source disposed off center with respect to the said central ridge, the combination combination comprising the ridge ventilator and one-half of a monitor ventilator mounted on the said roof with their rims at substantially the same elevation;

the said roof having two elongated ventilator openings in cooperative ventilating communication with the interior of the said building:

a ridge horizontal opening along the said central ridge; and

a lateral, outwardly presented vertical opening above the said heat source;

said roof having a raised portion on one side of the said ridge opening above the said heat source defining the said vertical opening;

the said ridge ventilator being disposed above the said ridge horizontal opening and having:

opposed side walls disposed parallel to each other and extending from (a) their base which is adjacent to the lateral edges of the said central horizontal opening upwardly and outboard of the said central horizontal opening to (b) an upper rim;

a cap member disposed between and apart from the said side walls and above the said central horizontal openings;

the said ridge ventilator having a pair of parallel gas passageways each located between the lateral edge of the said cap member and one of the said side walls;

the said one-half of a monitor ventilator comprising a cowling sheet element parallel with the said side walls of the said ridge ventilator, and a damper means;

the said cowling sheet element extending (a) from its base at the building roof below the bottom edge of the said vertical opening upwardly outboard of the said vertical opening (b) to an upper rim which is disposed above said vertical opening so as to prevent straight-line entry of precipitation into the interior of the building;

damper means disposed between the said cowling sheet element and the said raised portion of the roof for controllably obstructing the gas passage way between the said cowling sheet element and said roof.

No references cited.

WILLIAM F. O'DEA, *Primary Examiner.*