Sept. 6, 1966 L. COOK 3,270,656

VENTILATOR WITH AIR DISCHARGE MEANS

Filed April 27, 1964 2 Sheets-Sheet 1

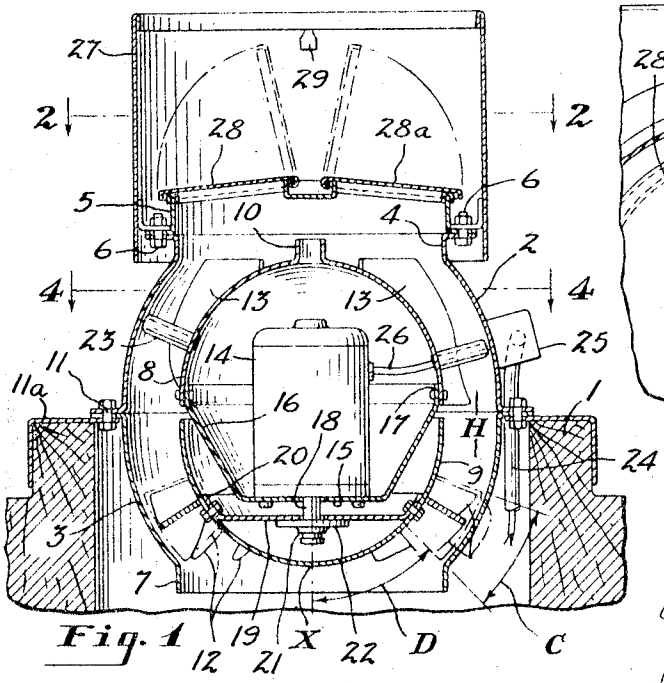


Fig. 1

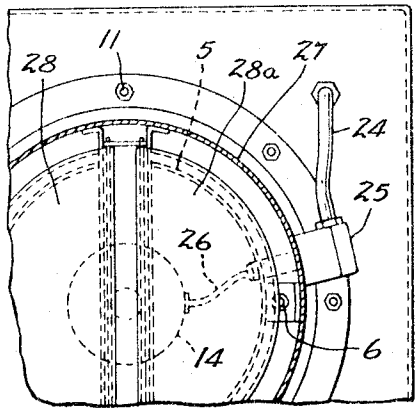


Fig. 2

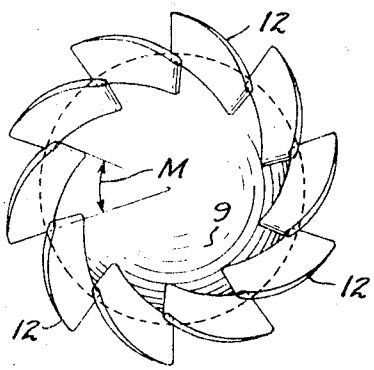


Fig. 3

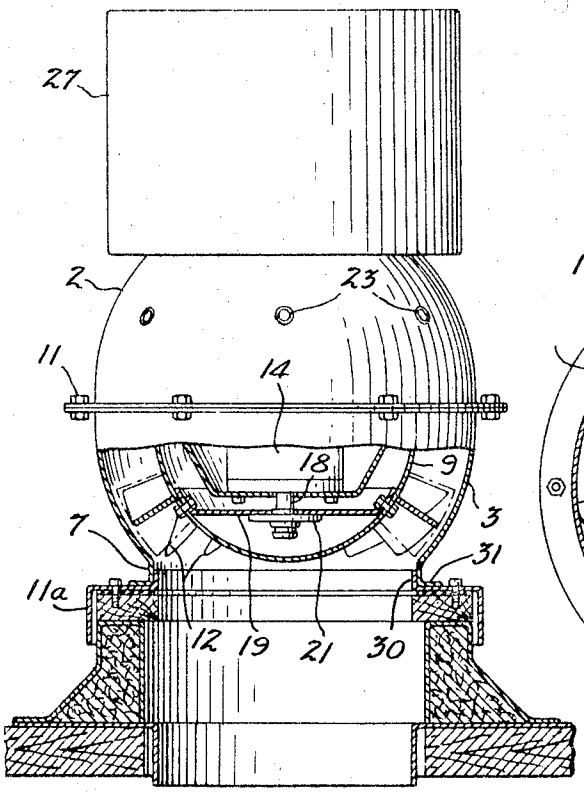


Fig. 5

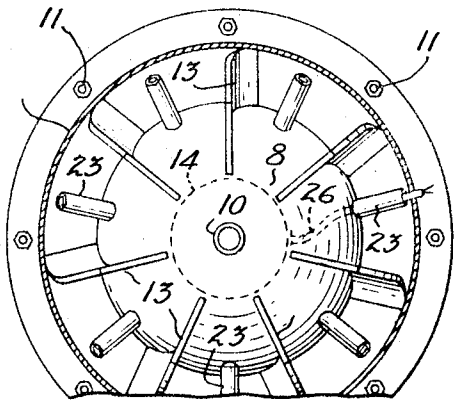


Fig. 4

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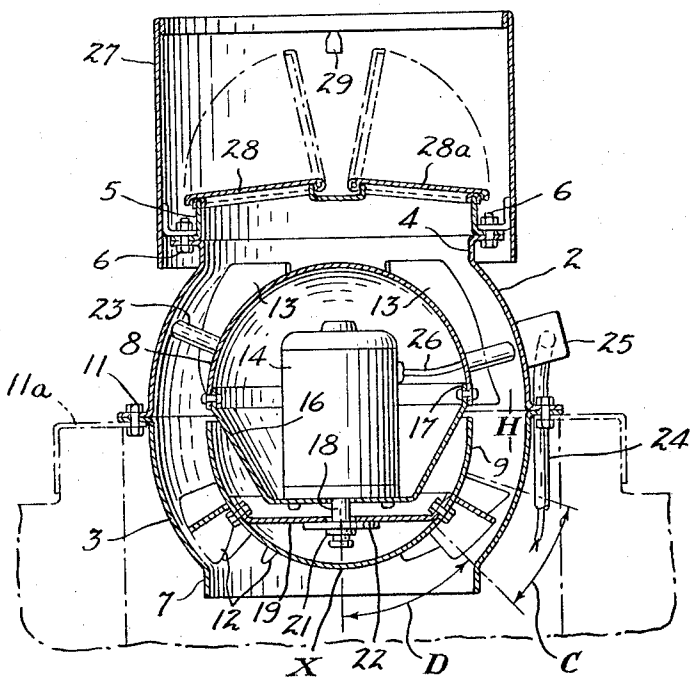


Fig. 6

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VENTILATOR WITH AIR DISCHARGE MEANS

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10 Claims. (Cl. 98—43)

My invention relates to ventilators that are compact in design and which are quiet and efficient in operation and is a continuation in part of application Ser. No. 228,558, filed in the Patent Office on October 5, 1962, which has matured into Patent No. 3,202,080. More particularly it relates to a ventilator in which means are provided to discharge the air in a substantially straight line away from the roof of the building.

In roof ventilators as heretofore constructed, air is drawn through the inlet duct means into the blower compartment in one direction and is exhausted through the outlet means in a direction substantially radial to the inlet means. Considerable pressure is therefore lost because of the resistance encountered in effecting a change in the direction of air flow. In prior ventilators, the area in the motor compartment is also frequently insufficient to accommodate a comparatively large motor. Another serious defect in prior roof ventilators is the lack of proper ventilation to cool the motor. In accordance with my invention, driving blades are provided at the air inlet duct means leading into the blower compartment and air turning vanes are provided in proximity to the outlet duct means to provide an improved roof ventilator in which the air is exhausted in a substantially straight line away from the roof of the building. To provide a substantially constant pressure within the ventilator, the cross sectional area of the air inlet means of my improved ventilator is the same or substantially the same as the cross sectional area of the plenum chamber within the ventilator and the cross sectional area of the discharge duct means leading from the ventilator. To prevent substantial turbulence within the ventilator, however, I have found that the number of air driving blades should not be the same as or any multiple of the air turning vanes.

My improved ventilator has a compartment which is large enough to accommodate a comparatively large motor. Improved ventilating means are also provided through which air flows to cool the motor which is arranged at a considerable distance downwardly from the exhaust opening and consequently air passing into the motor compartment to cool the motor is not contaminated with the exhaust gases. Means may also be provided, if desired, which is responsive to the discharge of air from the ventilator to increase the flow of air through the motor ventilating means as the speed of the motor and blower increase to dissipate the heat generated by the increased speed of the motor.

It is therefore an object of the invention to provide an improved roof ventilator by means of which air may be forced upwardly through the ventilator and away from the roof of the building in a substantially straight line.

Another object of my invention is to provide an improved roof ventilator of the straight line type in which the cross sectional area of the air inlet means, the cross sectional area of the plenum chamber within the ventilator, and the cross sectional area of the exhaust opening are substantially constant.

A further object of my invention is to provide an improved roof ventilator having a plurality of air driving blades in proximity to the air inlet duct means and a plurality of air turning vanes in proximity to the outlet duct means leading from the ventilator and in which the number of air driving blades is neither the same as or any multiple of the air turning vanes to thereby minimize air turbulence within the ventilator.

A still further object of my invention is to provide a ventilator including a pair of semispherically shaped outer casings secured together at their enlarged ends each of which has an outer open end, an inner casing having a stationary part which forms a motor compartment, a rotary impeller having blades thereon, the leading edge of each of which is arranged in close proximity to the stationary part of the outer casing and which cooperate with the stationary part of the inner casing in forming with the outer casing a blower compartment, inlet duct means leading into and outlet duct means leading from the blower compartment, air inlet means leading into the motor compartment and the stationary part of the inner casing having outlet duct means arranged axially with the outlet duct means leading from the blower compartment so that the discharge of air through the outlet duct means from the blower compartment draws air outwardly from the motor compartment which is replenished by air passing through the air inlet means leading into the motor compartment.

Other objects and advantages of my invention will become apparent as the specification proceeds.

My invention will be better understood by reference to the accompanying drawings in which:

FIG. 1 is a cross sectional view of one form of my improved ventilator;

FIG. 2 is a view taken on a plane passing through the line 2—2 of FIG. 1, looking in the direction of the arrows;

FIG. 3 is a perspective view of the lower end of the rotatable part of the inner casing;

FIG. 4 is a view taken on a plane passing through the line 4—4 of FIG. 1, looking in the direction of the arrows;

FIG. 5 is an elevational view with parts in section of the ventilator shown in FIG. 1 but showing a modification having means for mounting the ventilator on the roof of a building; and

FIG. 6 is a view similar to that shown in FIG. 1 but showing a modification of the stationary part of the inner casing.

One form of my improved ventilator is disclosed in FIGS. 1 to 4 of the drawings in which the lower portion of the ventilator is shown inserted within an opening in a curb 1 extending upwardly from the roof of the building. As shown, the ventilator includes an outer casing consisting of semispherically-shaped parts 2 and 3, each having an open end, part 2 terminating in a cylindrical throat 4 having an outwardly extending flange which is connected to an outlet duct means 5 by bolts 6, and part 3 terminating in a throat 7 which extends into the opening in the curb. The ventilator also includes an inner casing consisting of a stationary semispherically-shaped part 8, a motor supporting plate having a conically-shaped portion which terminates in a flange secured to the semispherically-shaped portion 8, and a rotatable semispherically-shaped impeller 9 which is connected to the shaft of the motor. The outer surface of the stationary part 8 has a convex portion which is tangent to a plane passing through the junction of part 2 and its throat 4 and terminates in an open tubular projection 10 arranged in axial alignment with the axis of the ventilator and the outer surface of the rotatable impeller 9 terminates in a convex portion X which is tangent to a plane passing through the junction of the second part of the outer casing and its throat. As shown in FIG. 1, the axis of the inner casing is in axial alignment with the axis of the outlet duct means 5 and the upper and lower parts of the outer casing are connected together at their enlarged portions by suitable means, such as bolts 11, which also extend through a suitable support, such as a base portion 11*a* that has a peripheral flange which fits over curb 1.

For drawing air from the building, a plurality of blades 12 are secured to the outer periphery of the lower rotat-

able impeller 9 which is driven by the motor arranged within the inner casing. As shown, the blades are of the air foil type and are relatively short and while the length of the blades of different size rotors will of course vary, in the modification shown, the root of each of the blades is approximately 2.7 inches and the tip is approximately 3.7 inches in length. As shown in FIG. 9, each of the blades has a concave portion facing the inlet to the ventilator and the angle C between the leading and trailing edges of each blade is approximately 25° and the angle D between the leading edge of each blade and the axis of the ventilator is approximately 45° and while the number of blades may be varied depending upon the size of the rotary part of the ventilator, in the modification shown, ten blades are provided and the angular distance between the leading and trailing edges of each of the blades on the periphery of the rotary impeller 9 is approximately 39° as indicated by the letter M in FIG. 3.

In my improved ventilator, the part 2 of the outer casing is connected to the inner casing by air turning vanes 13 which extend from the inner end of the conically-shaped portion 2 to the junction of the conically-shaped portion with the throat 4. Each of the air turning vanes is of an air foil type and has a slight bend therein to provide a substantially concave surface which is arranged in opposed relation to the concave surface in each of the air driving blades. The number of air turning vanes will of course depend upon the size of the ventilator. I have found, however, that if the number of air driving blades is the same as or is a multiple of the number of air turning vanes, air turbulence occurs in the ventilator. As shown, there are ten air driving blades and seven air turning vanes.

For rotating impeller 9, a motor 14 is secured to the base portion 15 of a casing 16 by suitable means, such as bolts. As shown the mounting plate has a conically-shaped wall 16 which terminates in an annular flange 17 which is welded or otherwise secured to the stationary part 8 of the inner casing. The shaft 18 of motor 14 extends through an opening in the base portion 15 of the mounting plate and through an aperture in a plate 19 having a conically shaped flange 20 to which rotatable impeller 9 is secured in any suitable manner, such as by bolts. The free end portion of shaft 18 terminates in a hub 21 to which it may be secured by suitable means, such as a set screw, not shown. Hub 21 has a flange 22 secured thereto which is also secured to mounting plate 19 and consequently when motor 14 is energized it rotates impeller 9.

It will be noted that a comparatively large space is provided within the inner casing 9 and the conically-shaped portion 16 for the motor which may therefore be of a comparatively large size and that the air driving blades are spaced a substantial distance from the convex end X of the impeller so that a comparatively large number of blades may be applied thereto.

For cooling motor 14, a plurality of tubes 23 are provided which extend through the part 2 of the outer casing and through the stationary part 8 of the inner casing and while the number of breathing tubes may be varied, as shown, a breather tube is arranged between each pair of air turning vanes. Motor 14 may be energized in any suitable manner. As shown, a tube 24 which forms a housing for electrical conductors extends from inside the room or building to which the ventilator is applied to a junction box 25 and conductors 26 pass from the junction box through one of the air tubes to the motor.

In the modification shown in FIGS. 1 to 4, the conically-shaped part 3 of the outer casing is arranged at such distance from the rotatable impeller 9 that the tip portion of the leading edge of each of the blades 12 is arranged in proximity to the part 3 of the outer casing at the junction of the part 3 with its throat 7. The conically-shaped part 2 of the outer casing is also arranged at approximately the same distance from the stationary part of the inner casing as the part 3 of the outer casing is arranged from the rotatable impeller and the trailing edge of each of the air turning vanes 13 terminates at the junction of the semisperically-shaped part 2 of the outer casing with its throat 4. By arranging the tip of the leading edge of each of the blades in line with the junction of the part 3 with its throat 7, a substantially straight line flow of air into the ventilator with the minimum resistance is obtained and in a like manner by arranging each of the air turning vanes so that the trailing edge of each vane terminates at the junction between the semispherically-shaped part 2 and its throat 4, air is discharged from the ventilator with the minimum of resistance.

In accordance with my invention, the air driving blades are comparatively short and the outer casing is arranged in such close proximity to the impeller 9 that a static pressure is built up in the area H between the outer casing, the impeller 9, and the air driving blades and the air turning vanes. From comparative tests, it has been found that when the angle C formed by a plane passing through the leading edge and a plane passing through the trailing edge of each blade is an acute angle of approximately 25° as shown in FIG. 1, the driving blades are particularly efficient during rotation in drawing air smoothly into the ventilator and discharging it therefrom with less impact than when the angle varies substantially from 25°. When the blades are comparatively short, the cross sectional area of the space H between the inner and outer casings and the air driving blades and the air turning vanes is comparatively large which permits air to be built up within the ventilator and because of the low air turbulence the part 9 of the ventilator may be efficiently rotated. The fact that the air turning vanes are slightly concave also aids in providing a straight line flow of air through the ventilator. In my improved ventilator as shown in FIGS. 1 to 4, there is a distinct combination between the short air driving blades, the air turning vanes, and the plenum chamber H arranged between the impeller 9 and the outer casing and the air driving blades and the air turning vanes which permits air pressure to be built up within the ventilator because when such a combination is present, it has been found that air from the inlet duct means may be drawn into the ventilator in a substantially straight line flow and discharged in a substantially straight line flow into the outlet duct means with substantially no turbulence. In the modification shown in FIGS. 1 to 4, it will also be noted that the cross sectional area of the inlet duct means and the cross sectional area of the plenum chamber H between the impeller 9 and the second part of the outer casing is approximately the same as the cross sectional area of the throat of the first part of the outer casing and its outlet duct means. By providing such an arrangement, air passing through the ventilator will have a substantially constant pressure and velocity.

When air is forced outwardly through the throat 4 and the duct means 5, air is drawn outwardly from the motor compartment through the outlet tube 10 which is replenished by air passing into the motor compartment through the breather tubes 23. The motor is therefore protected from air passing from the building that may be contaminated with fumes from the room of the building.

To protect the ventilator from weather elements when the ventilator is installed upon a roof, an annular baffle 27 is provided which may be mounted in place in any suitable manner. As shown, a plurality of angularly-shaped brackets are provided, one flange of each of which is secured to the baffle by suitable means, such as by welding or bolts, and the other flange of which extends inwardly over the outwardly extending mating flanges on the throat 5 and conduit means 4 and is secured thereto by bolts 6 which connect the two flanges together. A pair of dampers 28 and 28*a* are also provided which are pivotally mounted upon rods extending through the base portions of brackets secured to the opposite sides of the baffle, each damper being limited in its pivotal movement by a stop

29. The dampers close by gravity. When motor **14** is energized, however, air is forced outwardly through duct means **5** which opens the dampers and when the motor is deenergized, the dampers return to their normally closed positions. As shown, the upper surface of each of the dampers is inclined downwardly so that when weather elements, such as rain or melted snow or ice, fall upon the dampers or snow or ice melts thereon, the water flows downwardly between the baffle and the duct means **5**. Rain falling upon the interior of the baffle or water from melting snow or sleet which falls on the inner wall of the baffle also drains off between the baffle and conduit means **5**.

The modification shown in FIG. 5 is similar to that shown in FIG. 1 and the parts have been designated by the same reference numerals. In the modification shown in FIG. 5, however, the base **11***a* terminates in an upwardly extending annular duct means or throat **30** and the cylindrical throat **7** of part **3** of the outer casing engages the throat **30** to which it may be secured in any suitable manner, such as by welding. The throat **7** also terminates in an annular outwardly extending flange **31** which may be secured to the base portion **11***a*.

In the modification shown in FIG. 5, it will be noted that the lower portion of the ventilator is mounted upon the upwardly extending curb so that air drawn outwardly from the building will be forced further away from the building than the modification shown in FIGS. 1 to 4.

The modification shown in FIG. 6 is similar to that shown in FIG. 1 and the parts have accordingly been designated by the same reference numerals. In the modification shown in FIG. 6, however, the outlet tube **10** leading from the motor compartment is omitted because it has been found in practice that when an outlet tube **10** is provided as shown in FIG. 1, some air from the building will flow through the tube **10** into the motor compartment and outwardly through the breather tubes **23** and this is particularly true during the initial rotation of the blower when the dampers are still closed. To prevent air being expelled from the building from passing into the motor compartment, it is generally desirable to omit the outlet tube **10** and this is particularly true if the air being expelled from the blower contains acid fumes. It has also been found that the outlet tube **10** is not necessary when breather tubes are provided between each pair of air turning vanes as shown in FIG. 4 because air in an amount sufficient to cool the motor will pass into the motor compartment through some of the tubes **23** and will pass out of the motor compartment through some of the other tubes.

What is claimed is:

1. A ventilator comprising first and second semispherically-shaped parts, the first part of which terminates in an outlet opening and the second part of which terminates in an inlet opening, means for connecting the enlarged end portions of said parts together to form an outer casing, a stationary inner casing having a substantially semispherically-shaped portion which is spaced from the outer casing and an end portion which is arranged in substantially axial alignment with the outlet end of the first part of the outer casing, a motor, means associated with the inner casing for supporting said motor, an impeller having a central portion and an outwardly inclined body portion, a plurality of air driving blades having their root portions secured to the outwardly inclined portions of said impeller and leading edges arranged in close proximity to the inlet portion of the second part of the outer casing, a plurality of air turning vanes arranged between and connected to the outer casing and to the inner casing and arranged at a substantial distance from the air driving blades to form a plenum chamber between the inner and outer casings and the air driving blades and the air turning vanes, a shaft driven by said motor which is operatively associated with said impeller, a support, and fastening means secured to the connecting means for the enlarged parts of the outer casing and said support for holding the ventilator in place.

2. A ventilator as defined in claim **1** in which the number of air turning vanes or any multiple thereof is different than the number of air driving blades.

3. A ventilator as defined in claim **1** in which the enlarged parts of the outer casing terminate in mating flanges having aligned apertures therein, and in which the means for securing said ventilator to said support extends through at least some of the aligned apertures in said flanges and is connected to said support.

4. A ventilator as defined in claim **3** in which said support constitutes a curb having an opening therein and an angular casing, one flange of which casing surrounds the curb and the other flange of which rests on the curb and has a portion extending over the edge of the opening in the curb which has spaced apertures therein and in which the means for suspending said ventilator in place consists of fastening means extending through aligned apertures in the mating flanges at the enlarged ends of the semispherically-shaped parts forming the outer casing and apertures in that portion of the flange of the casing which extends over the opening in said curb.

5. A ventilator consisting of first and second semispherically-shaped parts, the first part of which terminates in an outlet opening, means for connecting the enlarged end parts together, a motor, a stationary inner casing including a substantially semispherically-shaped portion and means associated therewith for supporting said motor, an impeller having an outer surface inclined toward the inner casing, the free end of which is spaced from the enlarged end portion of the semispherically-shaped part of the inner casing and which forms with the outer casing a blower compartment, a plurality of air driving blades having their root portions secured to the inclined portion of said impeller and their leading edges arranged in close proximity to the inlet of the second part of the outer casing for directing air into the blower compartment, a plurality of air turning vanes arranged between the inner casing and the outer casing and spaced from the air driving blades to provide a plenum chamber between the air driving blades and the air turning vanes and the inner and outer casings, and the number of air turning vanes or any multiple thereof being different than the number of air driving blades.

6. A ventilator for application to the curb on the roof of a building, said ventilator including an outer casing consisting of first and second semispherically-shaped outer parts which are connected together at their enlarged ends, the first part of which terminates in an outlet throat and the second part of which terminates in an inlet throat which throats are of substantially the same size and are arranged in substantial axial alignment with each other, a curb, means for securing a portion of said ventilator to the curb with at least the first part of the outer casing extending upwardly from the curb, a motor, an inner casing including a semispherical-shaped part and means associated with the semispherically shaped part of the inner casing and connected thereto for supporting said motor, an impeller having an upwardly inclined surface which is spaced from the wall of the semispherical-shaped portion of the inner casing to provide a blower compartment between the inclined walls of the impeller and the outer casing, a plurality of driving blades arranged angularly on the inclined portion of said impeller with the outer edge of each of said blades arranged in close proximity to the second part of the outer casing, each of which blades are slightly concave in shape to direct air into the blower compartment, a plurality of air turning vanes arranged between the inner casing and the outer casing, each of which has a concave surface which is arranged in opposed relation to the air driving blades to provide a substantially straight line flow of the air from the ventilator, cylindrical duct means connected to the throat of the first part of the outer casing

and damper means arranged to close the cylindrical duct means when said motor is at rest.

7. A ventilator for application to a curb on the roof of a building as defined in claim 6 in which the lower part of the outer casing is secured to said curb and substantially all parts of the ventilator extend upwardly therefrom.

8. A ventilator as defined in claim 6 in which the curb surrounds an opening in the roof, a casing having a peripheral portion surrounding the curb and a portion resting upon the upper portion of the curb and terminating in an upwardly extending duct means and in which the lower portion of the outer casing has a downwardly extending duct means and the inlet throat of the second part of the outer casing srrounds the upwardly extending duct means on said curb and is provided with an outwardly extending flange which is secured to the portion of the casing resting on the curb.

9. A roof ventilator for application to a curb on the roof of a building as defined in claim 6 in which the lower portion of the ventilator extends within the curb and means for securing the enlarged part of the ventilator to the curb.

10. A ventilator for application to a curb on the roof

of a building as defined in claim 6 in which the first and second parts of the outer casing have outwardly extending flanges with aligned apertures therein and an angularly shaped casing having a downwardly extending flange surrounding a portion of the curb and an inwardly extending annular flange extending over the edge of the opening in the curb and having apertures therein which are in alignment with the apertures in the flanges at the enlarged end portions of the semispherically-shaped parts of the outer casing, and means extending through the aligned apertures in said flanges for securing the semispherical parts of the ventilator together and to the inwardly extending flange of said angular member.

References Cited by the Examiner

UNITED STATES PATENTS

2,294,586	9/1942	Troller	230—117
2,668,491	2/1954	Gerlitz	98—43
3,045,579	7/1962	Jenn	98—43
3,102,679	9/1963	Rudy	230—117

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