Oct. 17, 1967 B. O. HOWARD 3,347,147

EXHAUSTER INCLUDING VENTURI MEANS

Filed March 2, 1967 2 Sheets-Sheet 1

Fig. 1

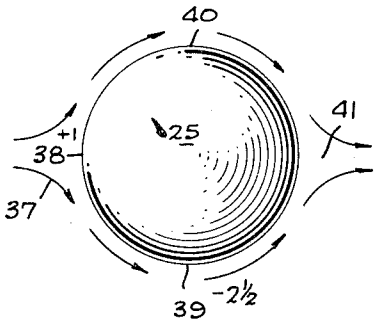


Fig. 2

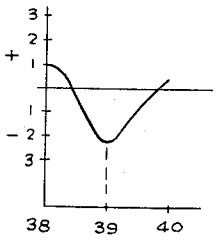


Fig. 3

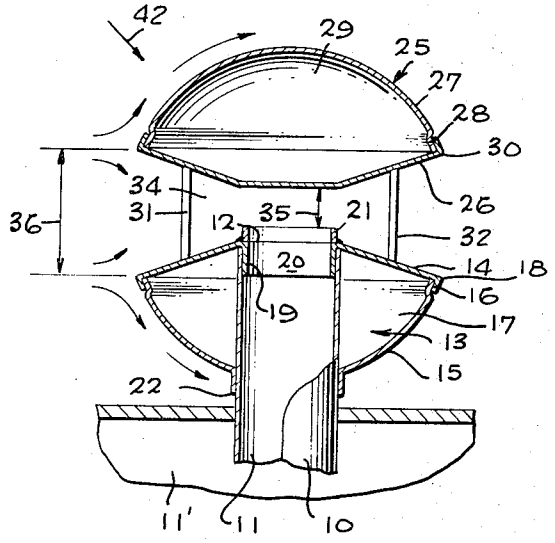


Fig. 4

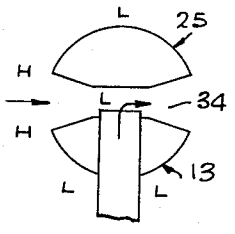


Fig. 4a

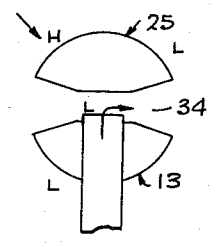


Fig. 4b

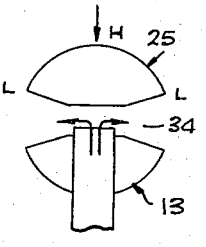


Fig. 5

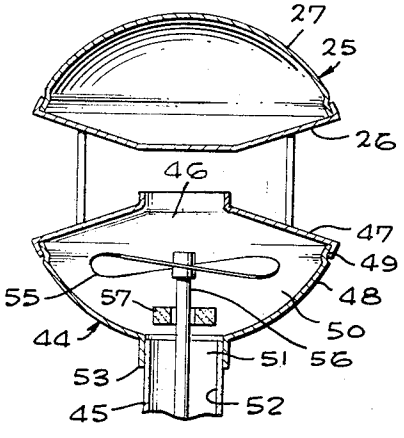
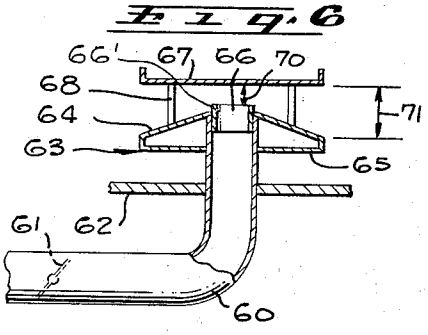


Fig. 6



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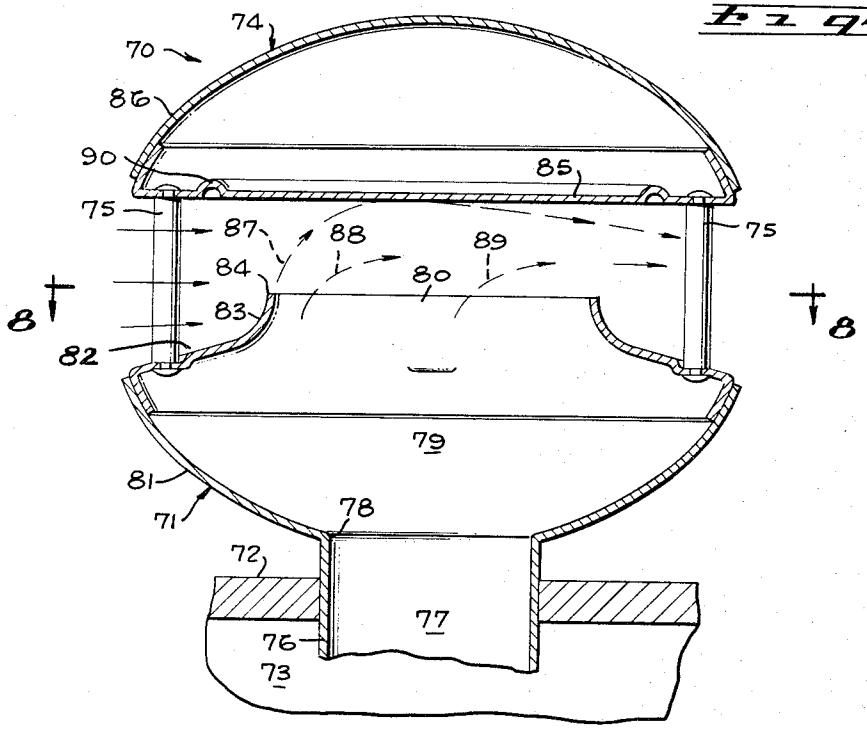
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Oct. 17, 1967 B. O. HOWARD 3,347,147

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Filed March 2, 1967 2 Sheets-Sheet 2

Fig. 7



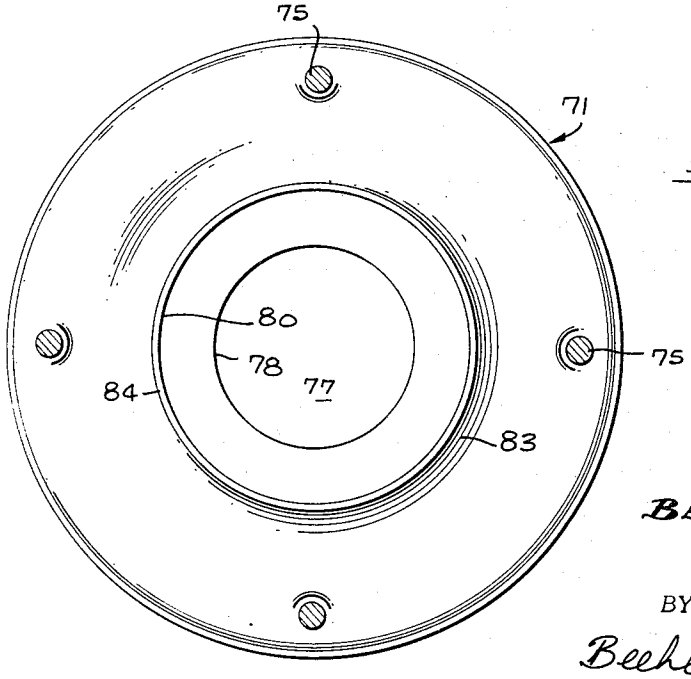


Fig. 8

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EXHAUSTER INCLUDING VENTURI MEANS

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4 Claims. (Cl. 98—78)

ABSTRACT OF THE DISCLOSURE

A two-part housing mounted upon an exhaust pipe which communicates to a chamber from which air is to be exhausted. The two parts when attached together form a rather generally spherical shape, the parts however being essentially separated one from another so that there is a horizontal passage between them for air. An upwardly facing outlet in the lower part provides for the passage of outflowing air from the vent pipe. A lower wall of the upper part is spaced a substantial distance above the outflow opening. A rounded outstanding flange around the outflow opening serves to deflect air upwardly into the space between the parts, so that this air, which is depended upon to generate flow of air from the outlet passage, does not obstruct the volume of air which is being drawn out, and it is for that reason that the lower wall of the upper part is spaced at a relatively great distance above the outflow passage.

Since the device depends upon a flow of air it is immaterial whether the flow of air be generated by wind blowing at the device or whether the device be placed upon some moving vehicle and the flow created by movement of the vehicle itself. Hence, the device is suitable for use on houses, buildings, shop, boats, trailers and virtually any type of chamber whether moving or not from which air or gas on the interior needs to be drawn outwardly.

This is a continuation-in-part of copending application Ser. No. 479,734, filed Aug. 16, 1965, which is directed primarily to a device incorporating the principles herein made use of, but which is only a spherical dome mounted directly upon an exterior surface.

Although forced ventilating means are commonly effective for exhausting stale air from a chamber of any kind, any type of forced ventilation requires a source of power, an appreciable amount of equipment, moving parts to be installed and serviced, and the attendant expense. For that reason, natural ventilation is made use of to a very great extent, though in many instances the performance of the ventilator as an exhauster is inadequate and even reversed in character. Some of the inadequacies arise from the fact that exhausters are too small to pass a sufficient volume of air outwardly. More frequently, the trouble lies in the fact that outer portions of the ventilators are poorly designed for their intended purpose, namely passing air outwardly to the atmosphere against a variety of atmospheric conditions which may involve wind blowing from an unfavorable direction or angle with respect to the horizon, currents and turbulence caused by surrounding structures and, frequently, a disadvantageous temperature differential. The most common impediment to good natural draft ventilation is the presence of wind blowing in one direction or another. To overcome the disadvantageous effect of wind some ventilators are provided with vanes employed for the purpose of orienting an adjustable ventilator hatch so that the opening is always downwind irrespective of which direction the wind may be blowing. This, of course, requires a mechanism involving moving parts which can on occasion get stuck. Even though the ventilator hatch is directed downwind it is designed to take advantage of the movement of air and often on the contrary is of such design that eddy currents of air generated by the wind actually block the free flow outwardly from the ventilator. On shipboard some use is made of ventilating funnels but these are strictly directional and need to be turned in the proper direction depending upon, in, part, the progress of the ship, and in part upon the direction of the prevailing wind. If such ventilators are set in the wrong direction they work in reverse and fail to serve as a proper ventilating media.

On still other occasions where stationary or relatively stationary ventilators are employed they must be roofed over or otherwise protected from rainfall and dirt. Some use has been made of rotating spheres and rotating vanes of various kinds which tend to shield the ventilating opening. Most vanes of the type currently employed have a tendency to impede the free flow of air and minimize the full effect of the ventilating system.

It is therefore among the objects of the invention to provide a new and improved stationary type of ventilator which is capable of performing effectively irrespective of which way air may be circulating about it, and without necessity for any adjustment to accommodate the direction of circulation of air.

Another object of the invention is to provide a new and improved stationary type of ventilator capable of handling a relatively large volume of air and which works equally effectively irrespective of the direction of air circulation and which at the same time is so arranged that rain and dirt cannot find its way into the outlet opening.

Another object of the invention is to provide a new and improved stationary type ventilator of such construction that air in motion about the outlet is made use of to greatly accelerate the ventilating effect.

Still another object of the invention is to provide a new and improved stationary type multidirectional ventilating device capable of being used on a stationary structure or upon a moving vehicle, the device being of such design as to always assure a markedly improved ventilating effect.

Still another object of the invention is to provide a new and improved multidirectional stationary type ventilating device which works with equal effectiveness whether used in upright or horizontal position or in fact in any desired position, which is relatively inexpensive to build, easy to install, capable of being constructed of virtually any available inexpensive sheet material, and which at the same time is attractive in appearance, or which can be cast, or molded of synthetic plastic resin material.

With these and other objects in view, the invention consists in the construction, arrangement and combination of the various parts of the device, whereby the objects contemplated are attained, as hereinafter set forth, pointed out in the appended claims and illustrated in the accompanying drawings.

In the drawings:

FIGURE 1 is a plan view of a typical ventilator embodying the invention and showing the pressure pattern resulting from air flowing about it in one direction;

FIGURE 2 is a graph of the pressure pattern produced by the air flowing about the device as pictured in FIGURE 1;

FIGURE 3 is a longitudinal view substantially cut away showing one form of the invention;

FIGURES 4, 4*a* and 4*b* are side sectional views showing different wind conditions;

FIGURE 5 is a longitudinal sectional view showing a slightly modified form of the invention;

FIGURE 6 is a longitudinal sectional view of still another form of the invention;

FIGURE 7 is a longitudinal sectional view of the invention in still another form; and

FIGURE 8 is a cross-sectional view on the line 8—8 of FIGURE 7.

In a device chosen for the purpose of illustration there is shown a stationary type exhaust ventilator comprising an outflow pipe section **10** having a passageway **11** therethrough comprising an outlet opening from a chamber **11'** and terminating in an exhaust aperture **12**. An inner hollow body **13** has an outer wall forming a substantially outwardly projecting surface **14** and an inner wall comprising a projecting surface **15** facing in an opposite direction from the surface **14**. On those occasions where the body is constructed of sheet material, it may be built in two sections, one forming the surface **14** and the other forming the convex surface **15** which when assembled and connected along a seam **16** forms a space **17**. At the seam **16** is a rounded edge **18** which extends circumferentially around the body. A flange **19** defining a hole **20** coincides with the outlet opening **12**, the flange **19** being fastened to the outflow pipe section **10** in some appropriate manner as for example by solder. A solder or weld line **22** fastens the central portion of the wall forming the convex surface **15** to the outflow pipe section **10**. Around the outlet opening **12** is an upstanding rim **21** to deflect air upwardly away from the hole **20** so that exhausted air will not be obstructed.

An outer hollow body **25** is constructed of one sheet metal portion forming an inwardly substantially convex surface **26** and another sheet metal portion forming an outwardly substantially convex surface **27**. The sheet metal portions are joined along a seam **28** forming a hollow space **29** within the body. The body moreover adjacent the seam **28** is in the form of an annular rounded edge **30**.

Stanchions like the stanchions **31** and **32** hold the outer hollow body **25** in position over the inner hollow body **13**.

Constructed as shown, there is a passageway **34** formed between the surface **14** and the surface **26** which has a center depth **35** substantially less than an outside depth **36**. The structure accordingly resembles a venturi or in fact a multidirectional venturi with the throat at the center, and the enlarged inlet and outlet at diametric extremities irrespective of the direction of air flow past the device.

As an example of the effect produced by the configuration disclosed, reference is made to FIGURES 1 and 2. On the assumption that a current **37** of air produced by any means impinges upon a point **38** of the annular body **25** producing a pressure at the point **38** of one inch of water at the chosen velocity, there will be a sufficient inchease in velocity at the points **39** and **40** to generate a negative pressure of about —2.5 inches of water. As the current of air passes and converges on the side diametrically opposite the point **38** at about the area **41** there will remain a negative pressure of about —.4 inch of water. In the graph of FIGURE 2 pressure is plotted in a vertical direction in inches of water against a distance in a horizontal direction from the initial point of impact.

A comparable effect takes place at the exhaust aperture **12** at the center where the velocity of the air current **37** is greatly increased causing the creation of a negative pressure at the outlet opening capable of drawing air outwardly through the passageway **11**. The ventilating effect produced in this fashion will increase depending upon the increase in velocity of the current of air. This will be true whether the current is the result of wind or whether it is the result of movement of a vehicle upon which the ventilator is mounted.

Reference to FIGURES 4, 4*a* and 4*b* will be helpful in explaning the ventilating action resulting from wind approaching from relatively different directions. For example in FIGURE 4 let it be assumed that the wind direction as shown by the arrow is horizontal. Passage of wind is generally shown by the arrows. In this form of the device there will be high pressure generated at the locations marked H and low pressure at the location marked L.

When under other circumstances as in FIGURE 4*a* the wind direction is in a downwardly oblique path as shown by the arrow. High pressure areas are indicated by the letter H and low pressure areas by the letter L. In this instance there will be some suction generated through the passageway **11** by venturi action similar to that generated in FIGURE 4 but most of the suction generated is due to the fact that the opening between the outer hollow body **25** and the inner hollow body **13** communicates with the low pressure area which is around the sphere perpendicular to the direction of the wind.

In the example of FIGURE 4*b* the wind may be assumed to be approaching vertically downwardly as indicated by the arrow. In this instance there is no venturi effect since air does not pass through the passageway **34**, as in the case of FIGURES 4 and 4*a*. In this instance air within the passage **34** travels entirely outwardly with respect to the passageway **11**, traveling to the low pressure area surrounding the composite device at a location perpendicular to the direction of the wind.

Although the reason for generating suction in the passageway **11** differs in the different instances, nevertheless in all wind conditions it will be apparent from the explanation that the ventilator functions to draw air outwardly through the passageway **11**.

In the form of device of FIGURE 5 substantially the same structural relationship is employed except that in this instance the outflow of pipe section has two parts, namely an inner part **45** and an outer part **46**, the outer part in fact being struck as a flange from a wall forming a substantially outwardly projecting surface **47**. Another wall forming an inwardly directed substantially convex surface **48** is joined to the wall forming the surface **47** along a seam **49** thereby to create a space **50**. The part **45** of the pipe section terminates in an opening **51** whereby a passageway **52** communicates with the space **50** and through the space **50** and the opening formed by the flange **46** to the atmosphere. A flange **53** is employed to mount the inner hollow body **44** upon the part **45** of the pipe section.

In this form of device there is provided an inertia fan **55** on a shaft **56** which is mounted by appropriate means (not shown) in the part **45** of the pipe section. By making use of an inertia fan, a more steadily continuing outward flow of air is maintained through the pipe section under circumstances where there may be a variation in the velocity of air flow past the device on the outside, whether created by gusty winds or a change in the speed of a vehicle upon which the device may be mounted. If desired, a motor winding **57** may be provided on the shaft **56** to drive the fan as a vent fan. When not in use as a motor, the winding acts as a fly wheel to improve the inertia effect.

In the form of device of FIGURE 6, a somewhat more simple version of the invention is shown. A vent pipe **60** containing a damper **61** extends through a wall **62** of some appropriate structure. At the outer end of the vent pipe is a body **63** consisting of a wall forming an outwardly projecting surface **64**. A flat wall **65** closing the opposite side of the body **63** may be employed for added strength. The body may be fastened to the vent pipe by appropriate conventional means as for example by soldering. The vent pipe **60** terminates in an exhaust aperture **66** at the center of the surface **64**. A canopy **67** is supported by stanchions **68** spaced outwardly relative to the exhaust aperture **66**. The canopy **67** is formed and located appropriately so as to provide a center depth **70** substantially less than a depth **71** around the periphery. A rim **66'** extends upwardly for the purpose already described.

Constructed in this fashion, when there is an air flow created between the surface **64** and the inside surface of

the canopy 67, increase in the velocity at the center opposite the exhaust aperture 66 thereby creates a negative pressure and outflow from the vent pipe 60.

In another embodiment of the invention illustrated in FIGURES 7 and 8, an exhaust fixture indicated generally by the reference character 70 is constructed in two parts, namely a first air foil comprising a housing 71 adapted to be mounted upon a wall 72 of a chamber 73, and a second air foil comprising a housing 74. Stanchions 75 mount the second air foil 74 on the first air foil 71.

More particularly, the first air foil includes a pipe section 76 having a passageway 77 therethrough forming an outlet opening 78 from the chamber 73, in this instance opening into an outflow chamber 79. An exhaust aperture 80, larger in area than the outlet opening 78, is substantially in alignment with the outlet opening.

A wall 81 is curved as shown in FIGURE 7, the exterior of the wall 81 being convex at the area adjacent its junction with the pipe section 76. The exterior of a wall 82 is annular in shape and also substantially convex, extending in a direction opposite from the convexity of the wall 81.

Of particular consequence is the provision of an annular flange 83 surrounding the exhaust aperture 80. The annular flange 83 has a definitely rounded concave shape, terminating in an annular rim 84 which extends in a direction substantially parallel to the direction of flow of air from the passageway 77 outwardly through the exhaust aperture 80. Although the flange 83 is shown rounded, other outwardly extending forms are also effective.

The housing 74 consists of a relatively flat wall 85 on the side facing the housing 71 and another wall 86, the exterior of which is convex in a direction facing away from the housing 71, the wall 86 being somewhat generally in the form of a portion of a sphere.

It is further significant that the clear space between the edge of the rim 84 and the surface of the flat wall 85 be relatively large, namely from about ⅛ to ¼ of the diameter of the exhaust aperture 84. It is also significant that the diameter of the exhaust aperture 84 be somewhat larger than the diameter of the passageway 77. Moreover, by having the wall 82 in the form shown, the space between the wall 82 and the flat wall 85 grows progressively larger from the inner end of the wall 82 toward its perimeter. This creates an annular space which forms the venturi-like configuration needed to induce a flow of air outwardly from the exhaust aperture 84, as air passes the two air foils in substantially any direction.

The presence of the flange 83 and its rim portion 84 is important in deflecting air entering the space between the two housings outwardly away from the exhaust aperture 80. By deflecting air in this manner the air deflected will travel outwardly until it impinges upon the adjacent surface of the flat wall 85 somewhere between opposite edges of the rim 84, following in general the broken line 87. By having the ambient air travel in this fashion, air being exhausted from the exhaust aperture 80, indicated by the broken lines 88 and 89, is able to escape in substantial volume without being inhibited by presence of the ambient air filling the throat of the venturi. Because the rim 84 is annular, the desired result will be experienced irrespective of which way ambient air may be flowing. Even though in a device of the stationary kind herein described, a satisfactory difference in pressure may be created by provision of a venturi-like structure, difference in pressure alone is insufficient to provide adequate exhaust ventilation unless there is an abundance of space for the exhausted air to escape without being blocked by the presence of ambient air in the space between the two housings. The structure described is especially advisable in a stationary exhaust ventilator of the type here under consideration where, without any motion or adjustment being provided in the device, it is capable of performing equally satisfactorily with ambient air flowing from any compass direction, and also with ambient air which may be moving downwardly at an angle or upwardly at an angle with respect to the exhaust ventilating device, within certain angular limits of a vertical approach.

On those occasions where the device may be constructed of sheet metal, by way of example, the housing 71 may be constructed in two parts and the housing 74 likewise in two parts. Good practice suggests that the stanchions 75 be fastened by appropriate means to the wall 82 and the flat wall 85 as a subassembly and thereafter securing the subassembly so that the wall 82 is fastened to the wall 81 by an appropriate conventional means such as welding or soldering and the wall 86 applied at its perimeter to the flat wall 85 in a similar fashion. An annular bead 90 may be provided in the flat wall 85 spaced outwardly relatively to the rim 84, forming a configuration serving as a stiffener for the flat wall 85 and also a water spoiler. In this way water which might flow over the surface of the flat wall 85 is inhibited from flowing inwardly far enough to fall into the exhaust aperture 80.

Since the geometry of the elements making up the spherical form of the ventilator and the spaced relationship is fixed and permanent, ventilating action can always be depended on whenever there is air movement relative to the device. Movement, of course, may be the result either of wind or movement of the device itself, as for example air movement created when the device is mounted on a moving vehicle and the vehicle moved relative to the air. Air speed is not critical and ventilation will be successful at a great variety of different speeds.

While the invention has herein been shown and described in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices.

Having described the invention, what is claimed as new in support of Letters Patent is:

1. An exhaust fixture for an interior chamber comprising an outflow pipe section adapted to connect to said chamber, said pipe section having an outlet opening, a first airfoil surrounding the outlet opening, said first airfoil comprising a housing having a wall on the side of said first airfoil opposite from said pipe section, the exterior of said wall being convex in a direction opposite from the pipe section, said wall having an exhaust aperture therein substantially in alignment with said outlet opening, there being an annular flange around said exhaust aperture, an outermost rim portion of said flange being substantially parallel to the flow path from said outlet opening through said exhaust aperture whereby to direct exterior air endwise relative to said rim portion, a second airfoil comprising a housing mounted at a spaced location from said first airfoil, said second airfoil comprising a relatively flat wall substantially parallel to the transverse plane of said flange and spaced outwardly therefrom, an outer annular portion of said relatively flat wall being spaced from an outer annular portion of the wall of said first airfoil a distance greater than the distance between said rim and said relatively flat wall, said distance being progressively larger toward the outer periphery, whereby to induce passage of air from said exhaust aperture.

2. An exhaust fixture for an interior chamber comprising an outflow pipe section adapted to connect to said chamber, said pipe section having an outlet opening, a first airfoil surrounding the outlet opening, said first airfoil comprising a housing having a wall on the side of said first airfoil opposite from said pipe section, the exterior of said wall being convex in a direction opposite from the pipe section, said wall having an exhaust aperture therein substantially in alignment with said outlet opening, there being an annular flange around said exhaust aperture, an outermost rim portion of said flange being substantially parallel to the flow path from said outlet opening through said exhaust aperture whereby to direct exterior air end-

wise relative to said rim portion, a second airfoil comprising a housing mounted at a spaced location from said first airfoil, said second airfoil comprising a relatively flat wall substantially parallel to the transverse plane of said flange and spaced outwardly therefrom and an exteriorly convex wall joined at its periphery to the periphery of said relatively flat wall, an outer annular portion of said relatively flat wall being spaced from an outer annular portion of the wall of said first airfoil a distance greater than the distance between said rim and said relatively flat wall, said distance being progressively larger toward the outer periphery, whereby to allow passage of air from said exhaust aperture.

3. An exhaust fixture for an interior chamber comprising an outflow pipe section adapted to connect to said chamber, said pipe section having an outlet opening, a first airfoil surrounding the outlet opening, said first airfoil comprising a housing having a first wall adjacent said pipe section, the exterior of said first wall being convex in shape adjacent said pipe section, a second wall on the side of said first airfoil opposite from said first wall forming with said first wall an outflow chamber, said second wall being outwardly convex in a direction opposite from the convex shape of said first wall, said second wall having an exhaust aperture therein substantially in alignment with said outlet opening, there being an annular arcuate flange around said exhaust aperture, an outermost rim portion of said flange being substantially parallel to the flow path from said outlet opening through said exhaust aperture whereby to direct exterior air endwise relative to said rim portion, a second airfoil comprising a housing mounted at a spaced location from said first airfoil, said second airfoil comprising a relatively flat wall substantially parallel to the transverse plane of said flange and spaced outwardly therefrom and an exteriorly convex wall joined at its periphery to the periphery of said relatively flat wall, an outer annular portion of said relatively flat wall being spaced from an outer annular portion of the second wall of said first airfoil a distance greater than the distance between said rim and said relatively flat wall, said distance being progressively larger toward the outer perimeter, whereby to induce passage of air from said exhaust aperture.

4. An exhaust fixture for an interior chamber comprising an outflow pipe section adapted to connect to said chamber, said pipe section having an outlet opening, a first airfoil surrounding the outlet opening, said first airfoil comprising a housing having a wall on the side of said first airfoil opposite from said pipe section, the exterior of said wall being convex in a direction opposite from the pipe section, said wall having an exhaust aperture therein substantially in alignment with said outlet opening, there being an annular flange around said exhaust aperture, an outermost rim portion of said flange being substantially parallel to the flow path from said outlet opening through said exhaust aperture whereby to direct exterior air endwise relative to said rim portion, a second airfoil comprising a housing mounted at a spaced location from said first airfoil, said second airfoil comprising a relatively flat wall substantially parallel to the plane of said flange and spaced outwardly therefrom and an exteriorly convex wall joined at its periphery to the periphery of said relatively flat wall, an outer annular portion of said relatively flat wall being spaced from an outer annular portion of the wall of said first airfoil a distance greater than the distance between said rim and said relatively flat wall, said distance being progressively larger toward the periphery, whereby to induce passage of air from said exhaust aperture, and an annular configuration in said outer annular portion of said relatively flat wall forming a water spoiler to inhibit flow of water toward said exhaust aperture.

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