United States Patent [19]

Ahlrich

[11] **3,865,022**

[45] **Feb. 11, 1975**

[54] **EXHAUST FUME TREATMENT APPARATUS**

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[22] Filed: **Mar. 7, 1973**

[21] Appl. No.: **338,871**

[52] **U.S. Cl.** ..... **98/115 K**, 55/406, 55/408, 55/DIG. 36

[51] **Int. Cl.** **F23j 11/02**

[58] **Field of Search** ..... 98/115 K, 115 LH; 55/406, 55/407, 408, 409, 401, 467, DIG. 36, DIG. 40

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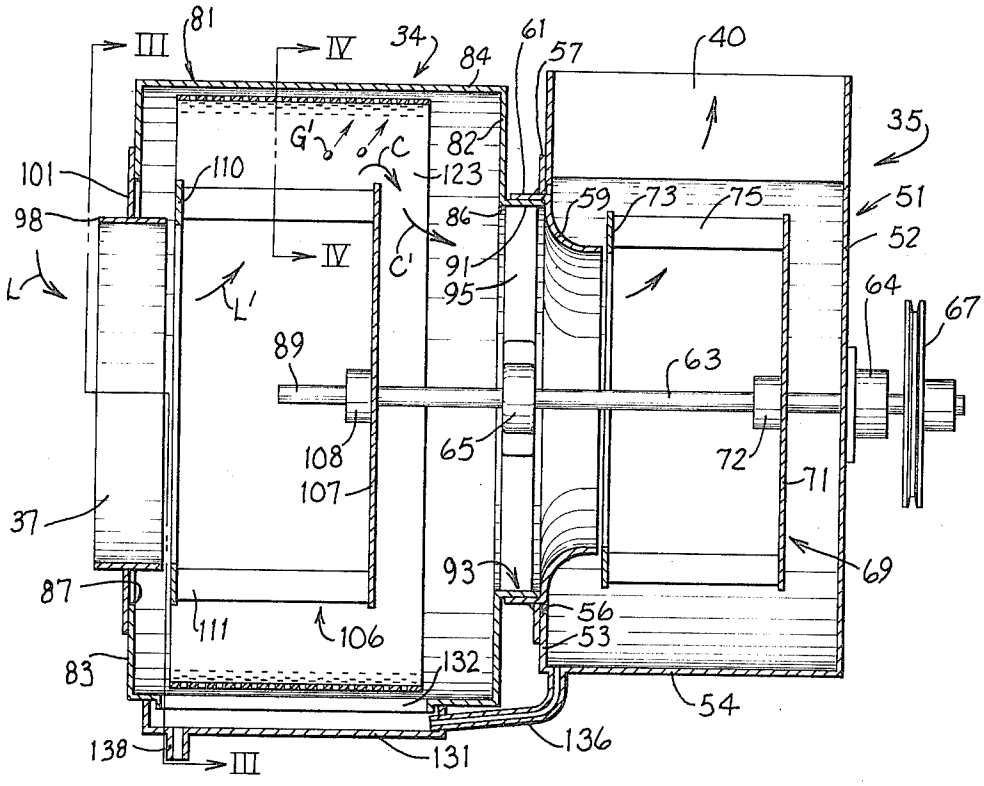
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Assistant Examiner—Paul Devinsky
Attorney, Agent, or Firm—Woodhams, Blanchard & Flynn

[57] **ABSTRACT**

An exhaust fume treatment apparatus for removing suspended or entrained material from a gas including a substantially cylindrical housing having a peripheral wall and inlet and outlet openings in opposite end walls. A suction blower coupled to the outlet of the housing has a rotatably driven shaft extending into the housing. A slinger wheel is rotatable on and with the shaft within the housing adjacent the inlet. The slinger wheel has an open face opposed to the inlet and a plurality of circumferentially spaced blades angled so the radially outer edge of each trails its radially inner edge during normal rotation of the shaft. Fumes drawn into the housing inlet by the suction blower pass outwardly through the blades and outlet. Materials in the gas are deposited on and thrown substantially radially outwardly by the blades toward the peripheral wall of the housing for collection. Embodiments of the invention shown disclose integration of the housing and suction blower with an exhaust hood having an air curtain. In one embodiment, an air curtain supply blower and the cylindrical housing and suction blower utilize coaxial conduits for communicating with an air curtain chamber and exhaust chamber, respectively, in the hood. In another embodiment, the air curtain supply blower shares a common shaft axis and drive motor means with the suction blower and cylindrical housing.

15 Claims, 8 Drawing Figures



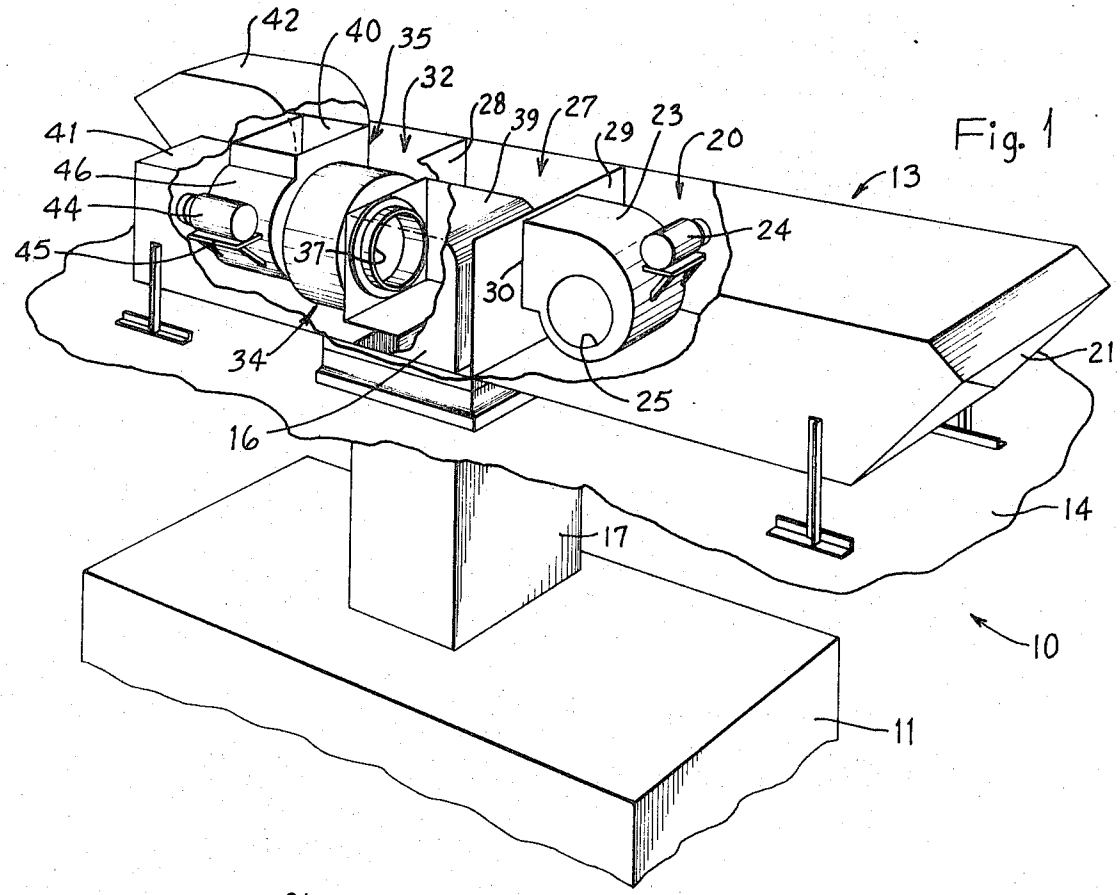

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Fig. 1

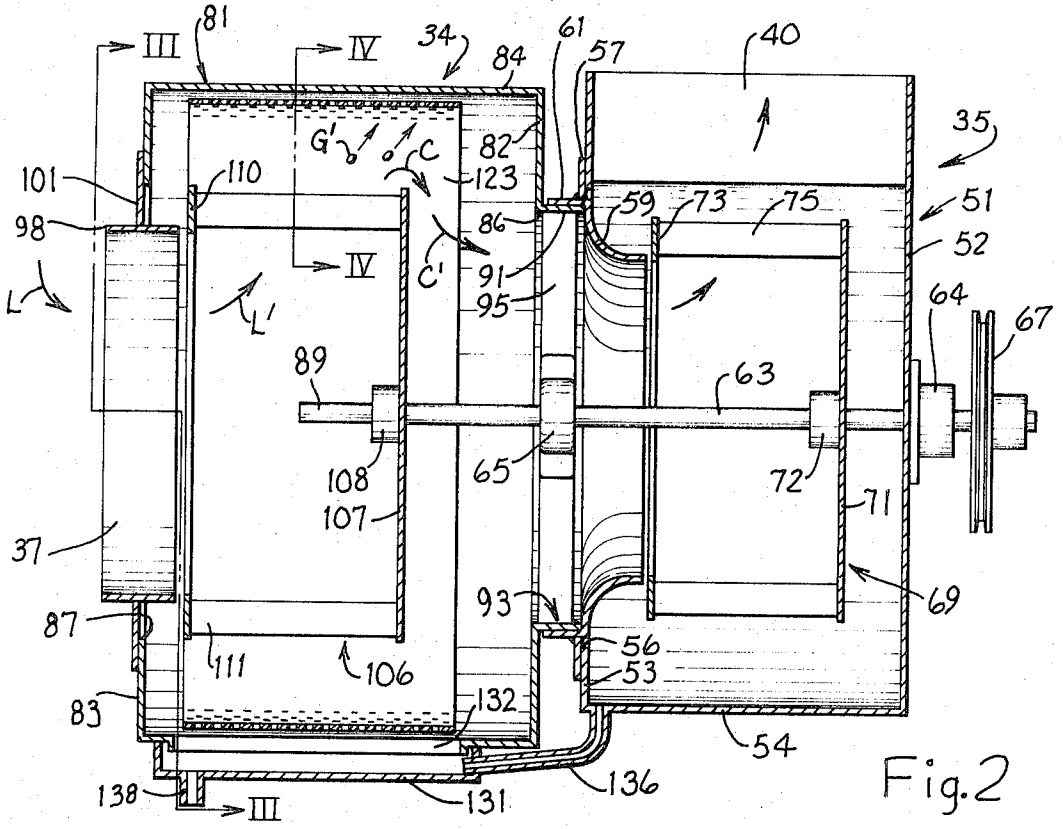

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L'
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63
108
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Fig. 2

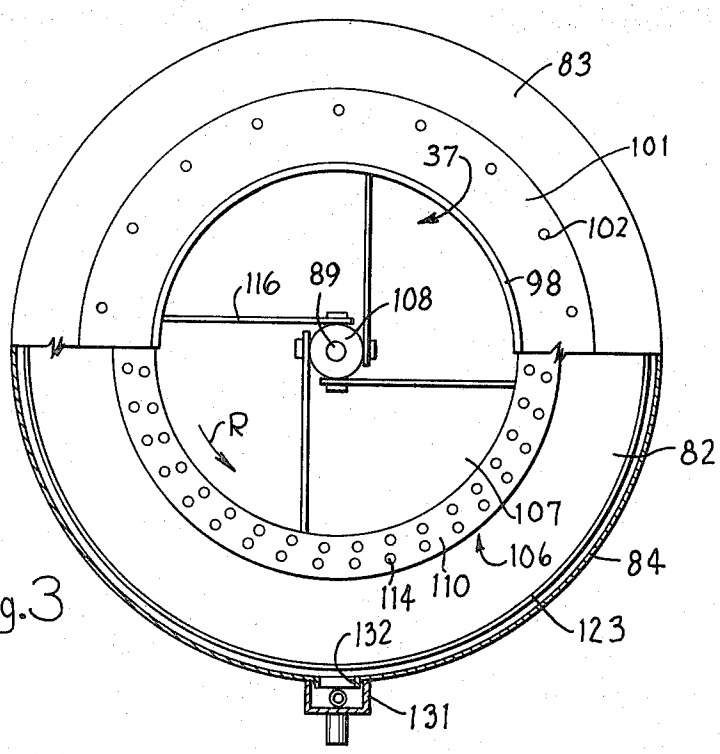


Fig.3

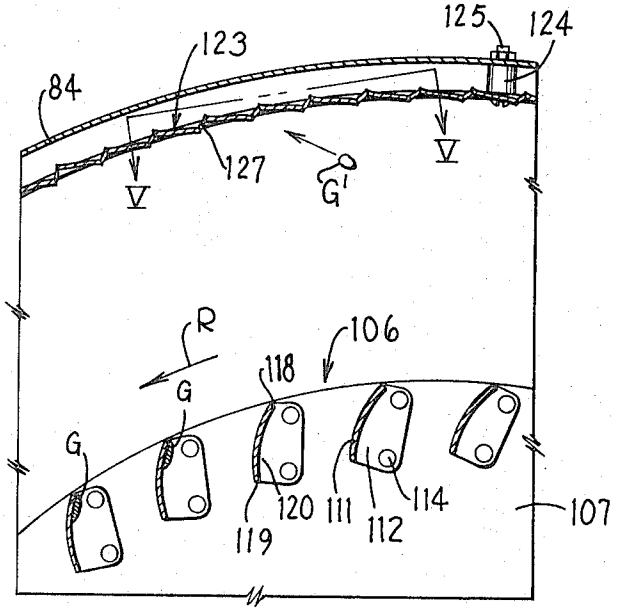


Fig. 4

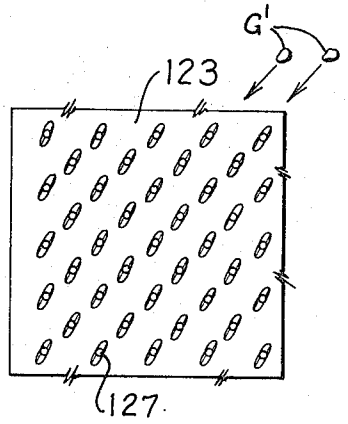


Fig.5

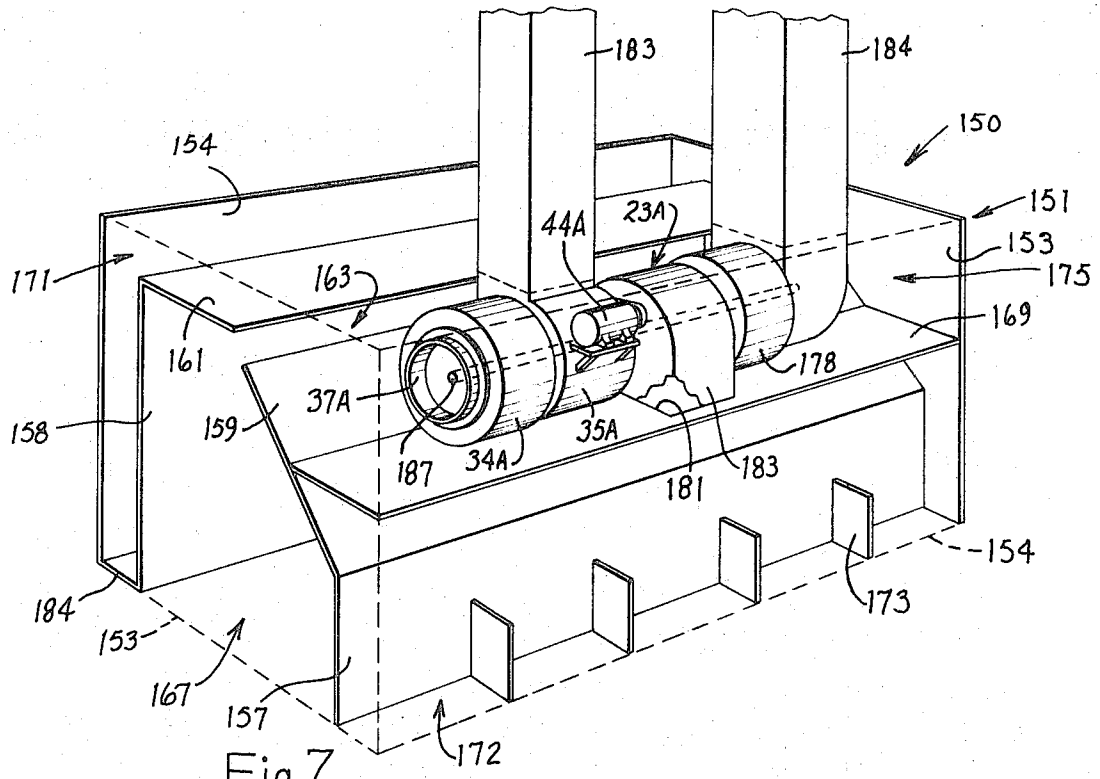


Fig.7

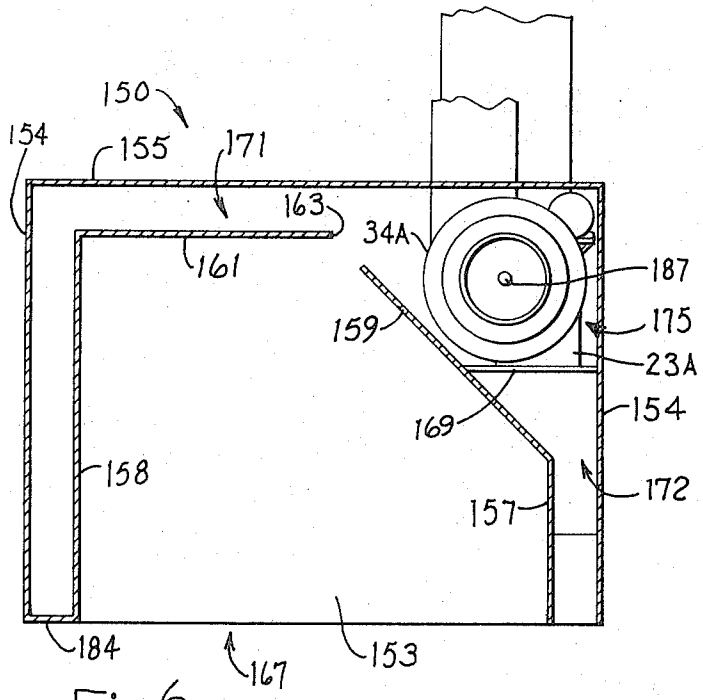


Fig.6

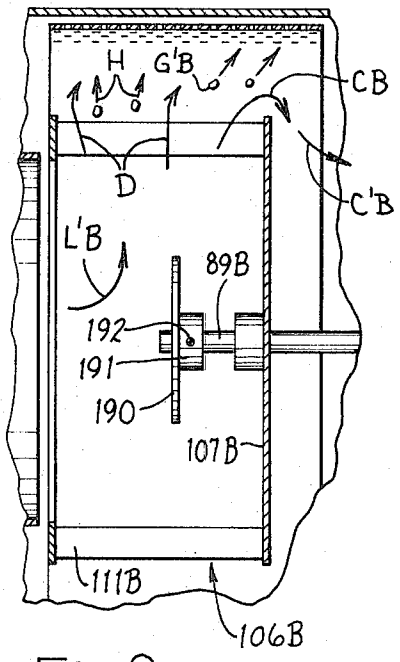


Fig. 8

EXHAUST FUME TREATMENT APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to exhaust fume treatment apparatus and, more particularly, relates to apparatus for removing materials from an entraining exhaust gas utilizing a rotating wheel and housing to effect such separation.

Although use in other environments is contemplatd, the present invention arose in connection with the development of exhaust hood systems and integrated exhaust hood-air curtain systems usable in a variety of situations in which fumes produced by a device are to be exhausted from an enclosure in which the device is located and in such a way as to protect personnel or the like adjacent such device from deleterious or unpleasant effects which might be caused by such fumes. Cook tops or the like in food preparation establishments including restaurants, hamburger stands, etc., provide one example of situations to which the present invention is directed.

In such establishments, the air above such cooking apparatus (for example, griddles, grills, open deep fat frying vats, kettles, pressure cookers, etc.) may frequently carry objectionable quantities of fatty or greasy materials in suspension or entrainment. It has been common in the past to exhaust such fumes from a collecting exhaust hood directly or substantially directly to the atmosphere and without treatment to remove suspended or entrained grease or other objectionable materials.

Recently increased public and governmental concern with degradation of environmental qualities, specifically with air pollution, has resulted in proposal and passing of statutes and ordinances at various governmental levels restricting outputs of air, containing objectionable or harmful pollutant materials, from a variety of business enterprises, including not only industrial concerns but other business enterprises as well. Food preparation establishments are at least a potential subject for such legislation. Thus, the present invention, in materially reducing or substantially eliminating the level of foreign materials, such as grease particles or the like, from air exhausted therethrough is intended to improve environmental quality.

Known prior art devices have not been fully satisfactory in providing convenient and effective removal of foreign materials, particularly sticky or liquid-like particles from air, particularly as heretofore used in connection with exhaust hoods. For example, it has been known to provide in the exhaust chamber of an exhaust hood, fixed filter devices including random strand mats or a series of plates defining a labyrinthian passage. Among their disadvantages, such devices tend to clog, are difficult and time consuming to clean and frequently cannot be relied on for removal of an acceptably high percentage of contaminant particles from the air passing therethrough. Attempts have been made in more generalized forms of gas-solid or gas-liquid separation to utilize movement of a member with respect to particle laden gas to effect separation of gas and particle. However, those of which I am aware suffer disadvantages including, for example, difficulty of integration with exhaust hoods and the like, undue complexity, excessive cost, or ineffectiveness in removing a high percentage of contaminant particles from air passing therethrough.

Therefore, the objects of this invention include provision of:

1. An exhaust fume treatment apparatus which removes solid or liquid particles from an exhaust gas preparatory to releasing same to the atmosphere.

2. Apparatus, as aforesaid, particularly adapted for use in combination with exhaust hood constructions, with or without air curtain devices.

3. Apparatus, as aforesaid, capable of removing substantial percentages, such as 80 to 95 percent of contaminant material from a suspending or entraining exhaust gas and which has been found particularly effective for removing fatty or greasy materials from such gas.

4. Apparatus, as aforesaid, particularly adapted to close integration with a conventional exhaust blower particularly of the centrifugal blower type which is capable of utilizing a rotating drive shaft and motor means with such exhaust blower.

5. Apparatus, as aforesaid, which may be relatively inexpensively constructed in large or small scale production from commonly available materials and/or components.

6. Apparatus, as aforesaid, which is capable of effective operation over long periods of time without attention, which tends to be self-cleaning in use, which provides for convenient elimination of contaminant materials extracted from exhaust air flowing therethrough and which provides for positive entrapment of material particles removed from the exhaust gas to prevent reentry of such particles into the exhaust gas flow.

Other objects and purposes of this invention will be apparent to persons acquainted with apparatus of this general type upon reading the following specification and inspecting the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary, partially broken oblique view of an exhaust hood, air curtain assembly incorporating the present invention.

FIG. 2 is a central cross-sectional view taken from the side of the extractor, exhaust blower apparatus of FIG. 1. FIG. 3 is a sectional view substantially taken on the line III—III of FIG. 2.

FIG. 4 is an enlarged sectional view substantially taken on the line IV—IV of FIG. 2.

FIG. 5 is a fragmentary sectional view substantially taken on the line V—V of FIG. 4.

FIG. 6 is a central cross-sectional view of a modified apparatus embodying the invention.

FIG. 7 is a fragmentary oblique view of the apparatus of FIG. 6 with the top and front portions of the outer hood wall indicated in broken lines.

FIG. 8 is a modified fragment of FIG. 2.

Certain terminology will be used in the following description for convenience in reference only and will not be limiting. The words "up," "down," "right" and "left" will designate directions in the drawing to which reference is made. The words "front" and "rear" will refer to the direction of gas flow through the apparatus, forwardly being the normal flow direction. The words "in" and "out" will refer to directions toward and away from, respectively, jthe geometric center of the device and designated parts thereof. Such terminology will include derivatives and words of similar import.

SUMMARY OF THE INVENTION

The objects and purposes of this invention are met by providing an exhaust fume treatment apparatus for removing suspended or entrained material from a gas including a substantially cylindrical housing having a peripheral wall and inlet and outlet openings in opposite end walls. A suction blower coupled to the outlet of the housing has a rotatably driven shaft extending into the housing. A slinger wheel is rotatable on and with the shaft within the housing adjacent the inlet. The slinger wheel has an open face opposed to the inlet and a plurality of circumferentially spaced blades angled so the radially outer edge of each trails its radially inner edge during normal rotation of the shaft. Fumes drawn into the housing inlet by the suction blower pass outwardly through the blades and outlet. Materials in the gas are deposited on and thrown substantially radially outwardly by the blades toward the peripheral wall of the housing for collection. Embodiments of the invention shown disclose integration of the housing and suction blower with an exhaust hood having an air curtain. In one embodiment, an air curtain supply blower and the cylindrical housing and suction blower utilize coaxial conduits for communicating with an air curtain chamber and exhaust chamber, respectively, in the hood. In another embodiment, the air curtain supply blower shares a common shaft axis and drive motor means with the suction blower and cylindrical housing.

DETAILED DESCRIPTION

FIG. 1 discloses an exhaust hood assembly **10** including an exhaust hood **11,** here including an air curtain device, which may be of any convenient conventional construction such as that shown in U.S. Pat. No. 3,645,194, issued Feb. 29, 1972, to Willard K. Ahlrich. The hood **11** may be supported in any convenient way (not shown) and is usable in conjunction with a source (not shown) of exhaust gas, such as a cook top or the like. An equipment enclosure **13** is supported by any convenient means, here on the roof **14** of a building housing the hood **11,** Coaxial inner and outer conduits **16** and **17** extend from the top of the hood **11** upwardly to the equipment enclosure **13.** An air intake chamber **20** is, in the particular embodiment shown, provided in the equipment enclosure **13** and opens through the rightward end **21** thereof. An intake, or air curtain, blower **23,** provided with a motor **24** is mounted within the air inlet chamber, at the inner end thereof, and has an inlet **25** in communication with the air inlet chamber. The equipment enclosure **13** includes a central chamber **27** closed by transverse end walls **28** and **29.** The outlet **30** of the air curtain blower **23** communicates through the wall **29** with the central chamber **27.** The central chamber **27** is an upward continuation of the outer conduit **17** and therewith provides communication between the blower **23** and an air curtain outlet (not shown) in the hood **11.**

An exhaust chamber **32** is provided in the equipment enclosure **13** to the left of the central chamber **27.** The exhaust outlet chamber **32** is closed except as otherwise discussed below. The exhaust outlet chamber **32** houses an extractor **34** and an exhaust blower **35,** both hereinafter described in more detail. In the particular embodiment shown in FIG. **1,** the inlet **37** of the extractor **34** is coupled through the wall **28** with a leftwardly angled extension **39** of the inner, or exhaust, conduit **16.** The exhaust blower **35** has an outlet **40** which communicates through a suitable opening in the outer wall **41** of the equipment enclosure **13** with a leftwardly and somewhat downwardly extending exhaust duct **42** which opens leftwardly to the atmosphere. A motor **44** is provided for driving the exhaust blower **35** and extractor **34,** in a manner hereinafter discussed, and in the particular embodiment shown is mounted by a bracket **45** on the scroll **46** of exhaust blower **35.**

More particularly, as to the extractor, exhaust blower unit **34, 35** (FIG. **2**), the exhaust blower **35** is preferably a conventional single inlet centrifugal blower comprising a housing **51** having end walls **52** and **53** jointed by a transversely extending, spiral-shaped peripheral wall **54** and defining therewith a blower outlet **40,** which is here substantially rectangular and opens upwardly. The leftward wall **53** has an inlet port **56.** An annular plate **57** is secured, as by welding, to the outer face of the sidewall **53** around the inlet port **56** and has secured, as by welding, to the radially inner edge thereof a radially inwardly and then axially inwardly curved inlet cone **59** which lies within the blower housing **51.** A cylindrical adaptor **61,** coaxial and preferably integral with the cone **59,** extends leftwardly and exteriorly from the blower housing **51.**

A blower shaft **63** is supported for rotation by bearings **64** and **65** and extends coaxially through the inlet cone **59.** The bearing **64** is located adjacent a shaft opening (not shown) on the outer face of the blower wall **52** and the bearing **65** is located adjacent the inlet cone **59** and adaptor **61** by means hereinafter discussed. The shaft **63** is rotatably driven, here through a pulley **67** fixed to the rightward end thereof and a drive belt (not shown) from a corresponding pulley on the shaft of the motor **44** of FIG. **1.**

A conventional open end centrifugal blower wheel **69** includes a rightward end plate **71** coaxially fixed to the shaft **63** by a conventional hub structure **72** and an annular leftward end plate **73** located closely adjacent the inlet collar **59** and supported on the rightward end plate **71** by means of a plurality of circumferentially spaced axially extending blower blades **75.** Thus, rotation of the blower wheel **69** in one rotational direction will move air rightwardly through the collar **59** and outwardly past blades **75** through the blower outlet **40.**

The extractor **34** includes a substantially cylindrical extractor housing **81** comprising coaxial, circular rightward and leftward end walls **82** and **83.** End walls **82** and **83** lie in spaced, substantially radial planes and are connected at their peripheries by a circumferentially continuous peripheral wall **84.** Openings **86** and **87** are provided in the end walls **82** and **83,** respectively, coaxially with the peripheral wall **84.** The blower shaft **63** includes a leftward end extension **89** which extends coaxially through the opening **86** into the interior of the cylindrical extractor housing **81.**

The housings **81** and **51** are spaced adjacent each other. An annular flange **91** is fixed as by welding to the wall **82** at the edge of the opening **86** and snugly telescopes within the adaptor **61** of the exhaust blower **35** for defining a transfer passage **93** from the extractor housing **81** to the inlet of the blower **35.** In the particular embodiment shown, a transverse web **95** extends chordally across the transfer passage **93** near the center thereof and fixedly supports the bearing **65,** the web **95** being secured to the interior of the flange **91** by any convenient means, such as welding.

An axially short, circularly cylindrical inlet collar **98** extends coaxially through the opening **87** in the leftward extractor housing wall **83** and is fixed, as by welding, to an annular flange **101** secured to the exterior face of the wall **83**, here by screws **102** (FIG. **3**).

A slinger wheel **106** (FIGS. **2–4**) includes a rightward end plate **107** coaxially fixed to the leftward end extension **89** of the shaft **63** by a hub structure **108**. The rightward end plate **107** is located within the extractor housing **81** in spaced relation between the bearing **65** and inlet collar **98**, the outer peripheral edge thereof being spaced radially inwardly from the peripheral wall **84**. The slinger wheel **106** includes an annular leftward end plate **110** coaxial with the rightward end plate **107** and located closely adjacent the inlet collar **98**. The annular leftward end plate **110** is supported on the rightward end plate **107** by a plurality of preferably identical, circumferentially spaced and axially extending blades **111**. In the particular embodiment shown, the blades **111** are provided with end flanges **112** secured to plates **107** and **110**, as by rivets **114**, and, particularly in larger-size units, suitable diagonal bracing rods **116** (FIG. **3**) may be provided between hub **108** and the annular flange **10**.

In the normal direction of rotation of the shaft **63**, (here counter-clockwise as indicated by the arrow R in FIGS. **3** and **4**, as viewed from the inlet collar **98** of the extractor **34**), wherein the blower wheel **69** acts in a conventional manner to draw air through the blower inlet cone **59** and impel same out the blower outlet **40**, the outer edges **118** of the slinger wheel blades **111** trail the radially inner edges **119** thereof. Thus, the slinger wheel blades **111** are arranged so that each lies at a shallow angle to a radius of the slinger wheel passing therethrough. In the preferred embodiment shown, the blades as seen in cross section in FIG. **4**, are slightly curved so that the trailing face **120** of each blade is somewhat concave. However, this curvature of the blades **111** has not been found absolutely essential to effective operation of the extractor, though it is helpful. Although the invention is by no means so limited, it has been found, in several embodiments of the invention which have been constructed, that the slinger wheel **106** may be a conventional open face blower wheel but of opposite hand to that of suction blower wheel **69**, that is, a conventional blower wheel intended for rotation in a direction opposite to that in which the shaft **63** actually rotates during operation of the extractor, exhaust blower unit **34, 35**. In contrast, it has been found by experimentation that use of a conventional blower wheel in its intended direction of rotation as a blower wheel, in place of slinger wheel **106** (that is, a wheel of the same hand as suction blower wheel **69**) is singularly ineffective for extracting particles from gas flowing through the extractor.

A cylindrical shield **123** (FIGS. **2** and **4**) is coaxially interposed between the slinger wheel **106** and the peripheral wall **84** of the extractor housing **81**. The shield **123** is radially remote from the periphery of the wheel and circumferentially close spaced from the peripheral wall **84**. The shield **123** is preferably fixed to the peripheral wall **84** by a plurality of suitable spacers **124** (FIG. **4**) and coacting nut and bolt connections **125** distributed circumferentially and axially thereof. The shield **123** preferably extends axially from about the leftward edge of the slinger wheel **106** rightwardly to a point intermediate the rightward end plate **107** and rightward end wall **82** of the extractor.

The shield **123** is perforated, having in the preferred embodiment shown a multitude of holes therethrough of about ⅛-inch diameter spaced on about ½-inch centers. As seen in FIGS. **4** and **5**, the holes **127** do not extend radially through the shield but rather extend therethrough in a sloped, or angled, manner. Such holes may be provided, for example, by drilling a radial hole through the shield and then using a punch or the like to upset the material at the rim of the hole so that one portion of the hole is pulled radially inwardly toward the wheel and the opposed portion is pushed radially outwardly toward the peripheral wall **84**. In the preferred shield shown, the net inclination of the holes **27** is at about 60° to a radius drawn from the shaft extension **89** or in other words, to about 30° to a plane tangential to the shield at the hole. Further, the direction of upset of the holes is preferably at about a 30° angle to a radial plane of the shaft **68**. By this means, the effective axis of each of the holes **127** is substantially aligned with the path which particles tend to take when thrown from the outer edges of the rotating slinger wheel.

A collection trough **131** (FIGS. **2** and **3**) is fixed, by any convenient means such as welding, to the bottom of extractor housing **81** and extends axially therealong at least for a distance exceeding the axial dimension of the shield **123**. A preferably downwardly flanged waste outlet opening **132** is provided in the bottom of the extractor housing peripheral wall in communication with the open top of the trough **131**, the opening **132** being almost coextensive with the top of the trough **131** in the preferred embodiment shown. In the preferred embodiment shown the blower housing **51** communicates at the bottom of peripheral wall **54** and near the leftward edge thereof, through a conduit **136** (FIG. **2**), with the rightward end of the trough **131**. The trough **131** is provided with an outlet conduit **138**, here adjacent the leftward end thereof, which may be terminated as desired.

The extractor **34** may be constructed in a wide range of sizes. The particular embodiment shown, for example, used a 24-inch external diameter slinger wheel **106** and an extractor housing **81** of about 36-inch diameter. The radial spacing from the tips of the blades of the slinger wheel to the shield **123** was about 5 inches and the radial spacing of the shield from the peripheral wall **84** of the extractor housing was about one-half inch. The axial spacing between the slinger wheel **106** and the rightward end wall **82** of the extractor housing is preferably a substantial fraction of the slinger wheel width, for example, 60–90 percent and in the particular embodiment shown was about 7½ inches with a wheel width of about 12½ inches. Thus, a substantial volume is provided between the slinger wheel and the peripheral and rightward walls of the extractor housing for air passing radially outwardly from the slinger wheel.

In the particular embodiment shown, the slinger wheel **106** is somewhat larger in diameter than the blower wheel **69**. However, this has been found not to be absolutely essential and, for example, satisfactory performance has been obtained with blower wheel diameters of about 80–100 percent of the slinger wheel diameter and even somewhat beyond.

OPERATION

Where the hood **11** includes provision for an air cur-

tain, as in the embodiment of FIG. **1**, energization of the intake, or air curtain, blower **23** causes intake air flow through the rightward end **21** of the equipment enclosure **13**, thence through the blower **23** and downwardly into the air curtain section of the hood through the central chamber **27** and outer conduit **17**.

To exhaust air from the hood **11**, motor **44** is energized to inturn energize the exhaust blower **35** and extractor **34**. Impurity laden exhaust air, for example, containing grease particles or the like in suspension or entrainment, is thus drawn from the hood **11** upwardly through inner conduit **16** and thence into the inlet **37** of the extractor housing **34**.

As seen in FIG. **2**, energization of the motor **44** rotates pulley **67**, shaft **63** and shaft extension **89**, such rotation being counterclockwise as seen from the inlet **37** of the extractor housing. Wheels **69** and **106** rotate with the shaft **63**. Rotation of the blower wheel **69** draws air from the inlet **37** of the extractor housing **81** through the slinger wheel **106** and thence rightwardly through the transfer passage **93** into the interior of the blower wheel **69**, whereafter the blades **75** of the rotating blower wheel **69** propel such air outwardly through the blower outlet **40**.

More particularly, particle laden exhaust air indicated by the arrows L and L′ enters the interior of the slinger wheel **106** through the inlet collar **98**. The particle laden air decelerates in moving radially outwardly past the blades **111** of the slinger wheel, moving at a much reduced speed radially outwardly from the slinger wheel and then rightwardly therefrom toward the transfer passage **93**. The moist or sticky particles in such exhaust air (which may include particles of oil, water, or grease, for example) tend to accumulate, or floculate, on the trailing faces of the slinger wheel blades near the outer edges thereof, as indicated at G on one of the blades in FIG. **4**. The amount of build-up G tends, in practice, to be somewhat greater toward the rightward end, as seen in FIG. **2**, of the blades **111**. The tip speed of the blades, resulting from rotation of the slinger wheel **106**, is sufficient that the accumulated masses of particulate material G are periodically released from their positions on the blades and impelled substantially tangentially outwardly, as indicated by for example the arrow G′ in FIG. **4**, toward the perforated shield **123**. The released masses normally strike the shield **123** at about a 30° angle to a tangential plane of the peripheral face of the shield.

Although the clean air leaving the slinger wheel **106** and flowing as indicated by the arrows C and C′ toward the transfer passage **93** is moving at a relatively slow velocity, the fact that there is a net air movement rightwardly tends to cause the particulate masses G′ released from the slinger wheel to migrate somewhat rightwardly as they move tangentially outwardly toward the shield **123**. As a result, the shield **123** extends rightwardly beyond the wheel sufficiently to be struck by the rightwardmost of such particulate masses G′ and the skewed openings **127** in the shield are correspondingly inclined axially, as seen in FIG. **5**, so that the paths of the masses G′ are closely aligned with the axes of the skewed openings **127**, thus facilitating entry of the particulate masses G′ through such openings. Each material mass G′, upon striking the inner face of the shield directly enters, or has sufficient velocity as to move on such face until it enters, one of the multitude of openings **127**. Each mass thus passes into the annular space between the shield and the peripheral wall **84** of the extractor housing. Particle masses within this space tend to drain by gravitation downwardly along the opposed faces of the shield and peripheral wall **88** to the bottom of the extractor housing and thence through the outlet **132** into the collection trough **131**, wherefrom they may continuously drain through suitable outlet conduit such as indicated at **138**.

Cleaned air, indicated by arrows C and C′, accelerates as it moves rightwardly and radially inwardly into the transfer passage **93** and inlet cone **59** of the exhaust blower **35** and thence is driven outwardly through the exhaust blower blades **75**. The cleaned air emerges from the exhaust blower outlet **40**.

For best performance with, for example, grease laden exhaust air, slinger wheel tip speeds in the range of 1,800 to 2,500 feet per minute have been found satisfactory, with speeds of 2,100 to 2,200 feet per minute being preferred. In one embodiment, built according to the present invention, given operation to provide about 3,000 feet per minute exhaust air velocity into the extractor inlet **37**, exhaust air deceleration through the slinger wheel blades area resulted in exhaust air speed of about 1,400 feet per minute outside the slinger wheel (between the slinger wheel blade and shield **123**), the air then accelerating into the transfer passage **93** and through the blower wheel **69** to achieve a velocity of about 3,000 feet per minute.

Measurements have indicated that the pressure drop from the inside to the outside of the slinger wheel is small but that a substantial pressure drop takes place at the transfer passage **93** and the inlet cone **59** of the exhaust blower which may range from, for example, ½-inch static pressure drop to several times that amount depending upon the particular embodiment under test.

Further testing was carried out to determine extraction efficiency. In one embodiment, utilizing a 16-inch diameter slinger wheel, cooking oil was sprayed into the inlet **37** utilizing a standard oil burner nozzle under 100 pounds of pressure at a rate of 1.1 gallons per hour at a temperature of 375°F. Measurement determined that about 92 percent of the oil introduced into the unit was recovered at the collection outlet of the extractor housing. Other testing was done, using a 13-inch diameter slinger wheel, with water introduced into the inlet **37** as a spray at about 1 gallon per hour, and no evidence was found of any water moving into the exhaust blower and collecting in the blower housing.

Further testing involving various modifications of the structure disclosed in FIGS. **2–5**, resulted in degraded performance. For example, removal of the exhaust blower **35** from its position shown in FIG. **2** and substitution of a remote suction source for drawing air through the extractor housing resulted in a substantial reduction in extraction efficiency, in one test reducing extraction efficiency from about 90 percent (on oil as above discussed) to about 75–80 percent. Similarly, tests involving a substantially closer radial spacing between the peripheral wall **84** of the extractor housing and the periphery of the slinger wheel (with a 13-inch diameter slinger wheel reducing extractor housing diameter from 17 inches to 15 inches) increased air velocity between the outside of the slinger wheel and the inside of the extractor housing and tended to keep portions of the oil contaminant air-borne rather than let-

ting it travel, as intended, outwardly toward the peripheral wall 84 for collection.

Other testing variations including, as examples, slinger wheel blades oriented reversely of the orientation shown in FIG. 4, or providing movement of exhaust air from outside the wheel inwardly therethrough have been found ineffective.

MODIFICATION

FIGS. 6 and 7 disclose a modified exhaust hood assembly 150. Portions of the modified hood assembly 150 corresponding to similar parts of the assembly 10 of FIG. 1 will carry the same reference numerals with the suffix A added thereto.

The assembly 150 includes a hood 151 having a substantially rectilinear outer wall construction comprising opposed end walls 153, opposed sidewalls 154 and a top wall 155.

An inner wall construction lies spaced within the outer wall construction 153–155 and comprises opposed front and rear walls 187 and 188, the upper portion 159 of the front wall 157 being sloped rearwardly (leftwardly as seen in FIG. 7) toward the rear wall 158. An inner top wall 161 extends forwardly from the rear wall 158 and is spaced rearwardly and above the upper edge of the front wall of the upper portion 159 for defining therebetween an exhaust slot 163. The walls 157, 158 and 161 extend between the end walls 153 of the outer wall construction. In the particular embodiment shown, a closure panel 184 connects the lower edges of the walls 154 and 158.

The inner wall construction 157, 158, 161 defines a downwardly opening exhaust gas collecting chamber 167. A separator plate 169 defines, between the inner and outer wall constructions, a pair of chambers, more particularly an exhaust transfer chamber 191 and a downwardly opening air curtain chamber 172, the former communicating through slot 163 with the exhaust collection chamber 167.

In the embodiment shown, the separator plate 169 is substantially horizontal and extends between the inclined front wall portion 159 and the forward one of the sidewalls 154 of the outer wall construction, providing an air seal therebetween. In addition, if desired, suitable baffles 173 may be provided near the open blower, or outlet, end of the air curtain chamber 172 for controlling and directing air flow downwardly thereout of.

An air moving unit generally indicated at 175 is disposed in the space between the inner and outer wall constructions and supported with respect to such wall constructions by any convenient means not shown. In the particular embodiment shown, the unit 175 is disposed in the exhaust transfer chamber 171. However, it is contemplated that the unit 175 can be disposed in the air curtain chamber, as hereinafter discussed.

The unit 175 comprises an extractor 34A and an exhaust blower 35A preferably similar to the extractor and exhaust blower of FIGS. 1–5. In addition, the unit comprises an air curtain blower 23A coaxially aligned with the extractor 34A and exhaust blower 35A and located adjacent the exhaust blower 35A. An intake air extractor 178, preferably similar to the exhaust extractor 34A, coaxially couples at its outlet to the inlet of air curtain blower 23A. The outlet portion 183 of the air curtain blower 23A communicates through a suitable opening 181 in the separator plate 169 with the air curtain chamber 172. Exhaust air outlet ducting 183 and air curtain inlet ducting 184 communicate from the outlet of exhaust blower 35A and inlet of air curtain extractor 178, respectively, upwardly through the top wall 154 of the outer wall construction for routing in any conventional manner to, for example, the exterior of a building housing the assembly 150.

A common drive shaft 187, which may comprise a coaxially coupled set of separate shafts extends coaxially through the unit 175 for mounting rotatably driving the wheels, not shown, of the devices 34A, 35A, 23A and 178. A common drive motor, here the exhaust blower drive motor 44A, is advantageously utilized to rotatably drive the common shaft 187 and hence the several wheels of devices 34A, 35A, 23A and 178.

It is contemplated that by pivotally repositioning the separator plate 169 upwardly and rearwardly so that it lies to the rear of the unit 175, the unit 175 can be housed in the air curtain chamber 172 rather than in the exhaust transfer chamber 171. In doing so, suitable ducting, not shown, may connect the inlet 37A through a suitable opening in such moved separator plate (in the manner for example, of the coupling of the outlet of air curtain blower 23A with the air curtain chamber 172 shown) so as to admit exhaust air from the exhaust transfer chamber thereto.

It is additionally contemplated that in certain instances, as desired, particularly wherein air supply by the ducting 184 is initially in a relatively clean, contaminant-free condition, that the intake air extractor 178 may be omitted, ducting 184 thus connected directly to the input of the air curtain blower 23A.

FIG. 8 discloses a modification of the extractor of FIG. 2, wherein corresponding parts carry the same reference characters with the suffix B added. In the FIG. 8 structure, a radially extending air deflector disk 190 is fixed to the left end portion of shaft 89B, by a hub 191 and any conventional locking means here including a set screw 192, for rotation therewith. The disk 190 is spaced from the right end plate 107B of the slinger wheel 106B.

The disk 190 deflects a portion of the incoming air L'B so that air flow out of the slinger wheel is more uniformly distributed along the length of the blades 111B (as seen at D and CB). In consequence, the particulate material build up on the blades 111B and the particulate masses H and G'B thrown outwardly from the blades tend to be more uniformly distributed along the length of the blades.

Although a particular preferred embodiment of the invention has been disclosed in detail for illustrative purposes, it will be recognized that variations or modifications of the disclosed apparatus, including the rearrangement of parts, lie within the scope of the present invention.

The embodiment of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. Exhaust fume treatment apparatus for removing contaminant materials from a gas, comprising in combination:

a substantially cylindrical extractor housing having a peripheral wall and an inlet and an outlet in opposite end walls thereof;

suction blower means coupled to the outlet of said housing for drawing gas therethrough and having a rotatably driven shaft extending into said housing;

a slinger wheel on and rotatable by said shaft and located in said housing, said slinger wheel having an open face adjacent said inlet and having a plurality of circumferentially spaced gas contacting blades each angled so that the radially outer edge thereof trails the radially inner edge thereof during normal rotation of said shaft, the opposed downstream ends of said slinger wheel and housing being spaced by an open air passage unoccupied except by said shaft; and

a shield spaced closely radially inboard of the said peripheral wall of said housing by a dead air space and being spaced remotely radially outwardly of said slinger wheel by a reduced gas velocity zone, the radial extent of said reduced gas velocity zone being at least several times that of said dead air space, said shield at least partially circumferentially surrounding said slinger wheel, said shield being pierced by a plurality of holes for receiving contaminant masses thrown outwardly by said slinger wheel and admitting same to said dead space between said shield and said housing peripheral wall;

means for increasing axial uniformity of material build up on said blades comprising a radially extending air deflector disk fixed to said shaft axially within said slinger wheel, the periphery of said disk being spaced radially intermediate the shaft and inner slinger blade edges.

2. The apparatus of claim **1** in which said slinger wheel blades are radially narrow and substantially spaced from said shaft, the upstream ends thereof being joined by a common annular end plate adjacent said extractor housing inlet, the cross section of said blades being curved to provide a concave trailing face adapted to continuously collect and periodically outwardly throw off contaminate material masses, said suction blower means having a bladed wheel similar to said slinger wheel but of opposite hand, whereby gas movement through said suction blower blades is accelerative and gas movement through said slinger wheel blades is not.

3. The apparatus of claim **2** including motor means coupled to said shaft for maintaining slinger wheel blade tip speeds in the range of 2,100 to 2,200 feet per minute.

4. The apparatus of claim **1** in which the spacing of the slinger wheel radially from the peripheral wall of the housing substantially exceeds the spacing of said wheel from said inlet, the axial width of said open air passage between said slinger wheel and downstream housing end wall being a substantial fraction of the width of said slinger wheel.

5. The apparatus of claim **1** in which the holes are skewed and the axis of each has at least a component substantially aligned with a tangent to the periphery of the wheel whereby contaminant masses thrown from the wheel tend to pass axially through said holes.

6. The apparatus of claim **5** in which said shield extends axially beyond said slinger wheel toward said downstream end wall of said housing, the axes of said skewed holes in said shield having a further component angled longitudinally of said shield and corresponding to the migration axially of the slinger wheel of contaminant masses thrown from the slinger wheel due to exhaust air movement from said slinger wheel toward said downstream end wall of said housing, whereby to provide alignment of said holes in said shield with the path of contaminant masses thrown from said slinger wheel despite migration thereof with air from said slinger wheel.

7. The apparatus of claim **1** in which said shield is substantially horizontal and including means defining a contaminant outlet at a low point in the peripheral wall of said housing for receiving contaminant masses entrapped between said shield and said housing peripheral wall.

8. The apparatus of claim **7** including a collection trough fixed to said housing in communication with said contaminant outlet for receiving contaminant masses therefrom, said contaminant outlet and trough extending axially along said housing substantially the width of said shield and radially opposed thereto.

9. The apparatus of claim **8** including a conduit communicating with a low point in said trough and wherein said suction blower means includes a housing and including a conduit communicating between a low point on said suction blower means housing and said trough for draining to said trough any contaminant material escaping from said extractor housing into said suction blower means housing.

10. The apparatus of claim **1** in which said suction blower means comprises a centrifugal blower having a housing through which said shaft extends, a centrifugal, open-faced blower wheel mounted on said shaft for rotation therewith and within said blower housing, an inlet opening in the side of said blower housing, said open-faced blower wheel having an air inlet opening of diameter substantially less than the diameter of said extractor outlet and means defining a convexly curved inlet cone interposed between said extractor outlet and blower wheel air inlet opening for smoothly correspondingly reducing air flow cross section therebetween during normal rotation of said shaft, said extractor housing and blower housing being located in coaxial, close-spaced relation, said extractor outlet and blower housing inlet opening being in coaxially aligned communication and including annular flange means extending between said housing and surrounding said last-mentioned openings for defining a transfer passage shorter than said wheels between said lastmentioned openings.

11. The apparatus of claim **10** in which said annular flange means comprises a pair of snugly telescoped flanges extending from said extractor housing and blower housing, respectively, and including a web extending across the inner one of said annular flanges and a bearing on said web, said bearing supporting said shaft and said slinger wheel in cantilevered relation within said extractor housing.

12. The apparatus of claim **1** including an exhaust hood, an elongate equipment enclosure spaced from said hood and an exhaust conduit interconnecting said hood and an intermediate portion of said elongate equipment enclosure, said extractor housing and suction blower means lying within and having their common shaft extending along one end portion of said elongate equipment enclosure from an extractor inlet coupling with said exhaust conduit to a substantially horizontally directed suction blower means outlet at one end of said elongate enclosure, the other end portion of said elongate enclosure defining an air inlet.

13. The apparatus of claim **1** including an exhaust hood having inner wall means defining a downwardly

opening exhaust chamber and outer wall means defining a downwardly opening air outlet chamber for establishing an air curtain, said extractor housing and suction blower means being disposed within said hood between said inner and outer wall means and for communicating said extractor housing inlet with said exhaust chamber.

14. The apparatus of claim 1 including an air supply blower having a shaft portion coaxial with and coupled to said shaft and common drive means for rotatably driving said shaft and shaft portion.

15. The apparatus of claim 14 including a further extractor housing and a further slinger wheel within said further extractor housing and mounted on said shaft portion for rotation therewith, said further extractor housing being coupled to the inlet of said air supply blower and an air curtain-exhaust hood having an air curtain chamber communicating with the output of said air supply blower and an exhaust chamber communicating with the inlet of said first-mentioned extractor housing, whereby ambient air is cleaned before being applied to the air curtain portion of said housing and exhaust air from said hood exhaust chamber is cleaned before release from said suction blower means.

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