Feb. 15, 1966 R. F. HARPER ETAL 3,234,713

DUST COLLECTOR

Filed Dec. 24, 1962 2 Sheets-Sheet 1

FIG. 1

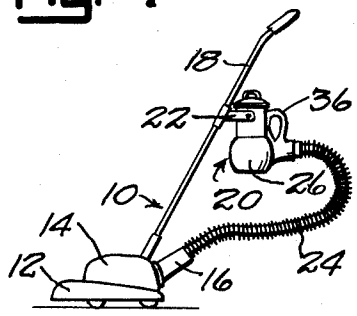

FIG. 2

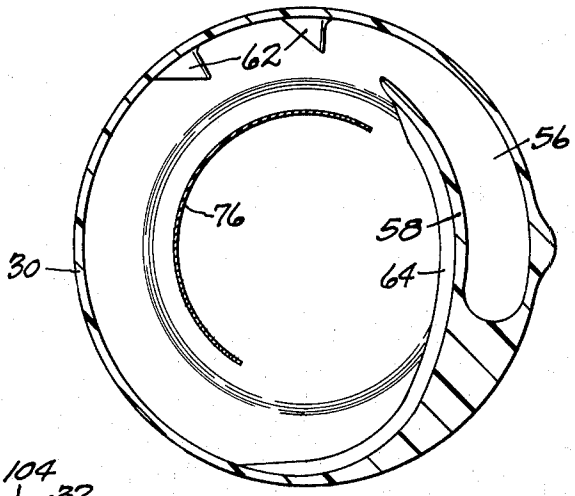

FIG. 4

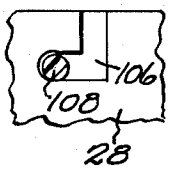

FIG. 3

FIG. 5

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Fig. 6

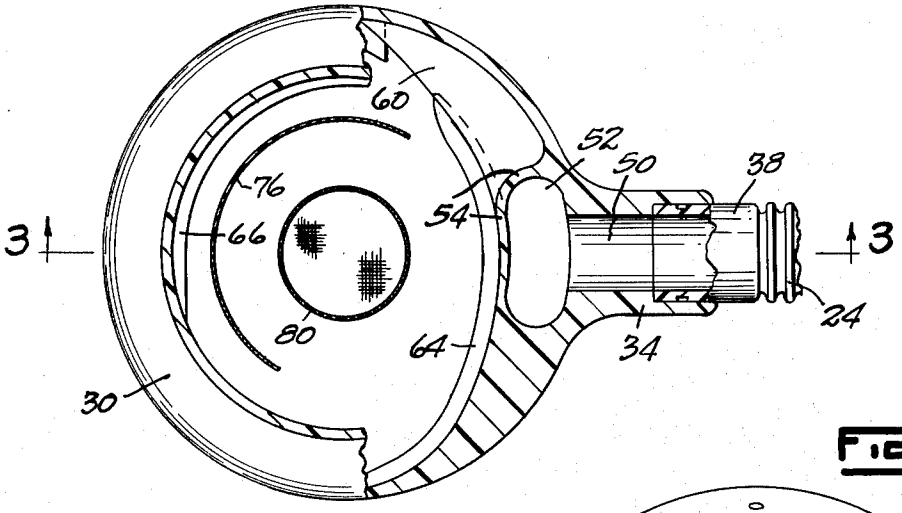


Fig. 8

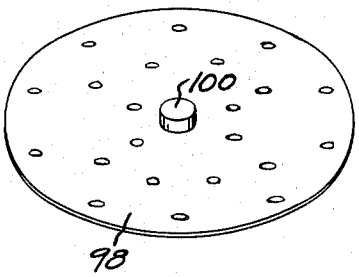


Fig. 7

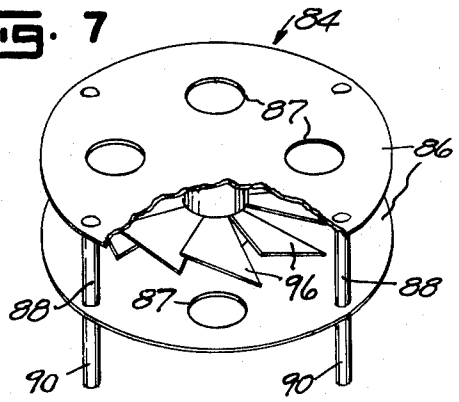
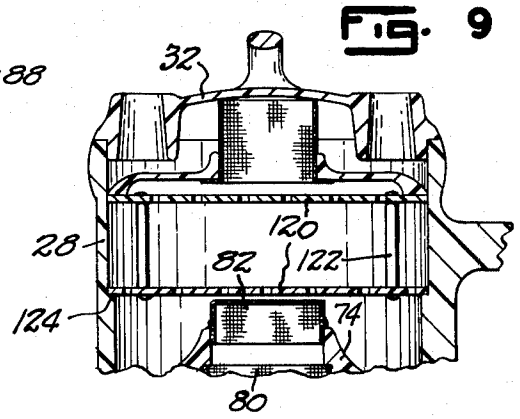


Fig. 9



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DUST COLLECTOR

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10 Claims. (Cl. 55—246)

This invention relates to improvements in dust collectors, and more particularly to a dust collector adapted to be used in conjunction with apparatus through which a forced flow of air occurs.

Devices such as vacuum cleaners and forced air heating and cooling systems, which require circulation of air for their proper operation and which pass air from atmosphere and return it to atmosphere, are commonly characterized by the movement of dust through the atmosphere.

Thus in a forced air circulating space heating or air conditioning system, although filters are commonly provided to entrap dust and dirt, such filters are now of limited efficiency in operation, and further tend to become clogged and to have negligible operating efficiency after a certain amount of dust has collected thereon. In the case of vacuum cleaners dirt is collected in a bag in one type thereof, but this bag must be porous to permit air to flow therethrough after discharging entrained dirt in the bag, and small particles of dust pass from the bag with the air being discharged. In other types of vacuum cleaners, various arangements of filters are employed but these have limited utility and efficiency.

It has previously been proposed to collect dust entrained in air in a forced air circulating mechanism by forcing the air through water to precipitate dust therefrom. Heretofore devices of this character have proven to be of limited utility for various reasons, such as excessive resistance to air flow, risk of splashing or discharge of liquid in conjunction with moving apparatus, such as vacuum cleaners, excessive weight and large size and excessive entrainment of moisture in the air.

It is the primary object of this invention to provide a novel, simple, inexpensive, highly efficient device for precipitating dust into liquid as a means to collect dust.

A further object is to provide a device of this character having a novel path of flow of air therethrough in such a manner as to insure air flow through sufficient water to precipitate dust with minimum resistance to air flow.

A further object is to provide a device of this character with a circuitous passage for the flow of air to substantially preclude loss of liquid if the device is tilted or subjected to impact or reciprocatory movement during use in a manner tending to cause the liquid to splash.

A further object is to provide a device of this character with novel means for extracting excessive moisture from the air being discharged therefrom.

A further object is to provide a device of this character which can readily be attached to and removed from a forced air circulating system and which can readily be dismantled for cleaning and repair.

Other objects will be apparent from the following specification.

In the drawings:

FIG. 1 is a view illustrating the device mounted upon and used in conjunction with a vacuum cleaner;

FIG. 2 is a horizontal sectional view taken on line 2—2 of FIG. 3;

FIG. 3 is a vertical sectional view taken on line 3—3 of FIG. 6;

FIG. 4 is a fragmentary detail view observed in the direction of the arrows 4—4 in FIG. 3;

FIG. 5 is a fragmentary detail sectional view taken on line 5—5 of FIG. 3;

FIG. 6 is a horizontal sectional view taken on line 6—6 of FIG. 3;

FIG. 7 is a perspective view of a sub-assembly of the device with parts broken away;

FIG. 8 is a perspective view of another part of the device;

FIG. 9 is a fragmentary vertical sectional view illustrating a modified embodiment of the invention.

Referring to the drawings wherein we have selected to illustrate the device as applied to a vacuum cleaner, the numeral **10** designates a vacuum cleaner of the type having a wheeled carriage **12** incorporating a motor-driven suction unit **14** having a discharge outlet **16**. The cleaner is provided with a handle **18** by means of which it is manipulated. Our improved dust collector **20** is adapted to be mounted upon the handle **18** by a suspension bracket **22** and to be connected to the discharge outlet **16** of the suction unit **14** by means of an elongated flexible conduit **24**. Alternatively, the collector **20** may be mounted detachably on the carriage **12**, as will be obvious.

The dust collector **20** comprises a housing **26** which may be formed of metal, plastic or any other suitable material and which preferably has a substantially cylindrical or tubular upper portion **28** and a slightly enlarged or bulbous lower housing part **30**. A removable cover or lid **32** is carried by the upper housing part **28**, and an inlet portion **34** communicates with the lower housing part **30**. If desired, a handle **36** may be provided upon the housing **26**. Any suitable means are provided for detachable connection of the housing **26** to the end of the flexible conduit **24**. Thus, as illustrated in FIGS. 3 and 5, a flexible conduit **24** may have a tubular end part or fitting **38** provided with a circumferential groove **40** into which fits the end of a pin **42** for locking the fitting in selected position in the interior of the inlet **34**. The locking pin **42** is shiftable endwise in a lock pin socket **44** of the housing which includes a spring chamber mounting a coil spring **46** normally urging pin **42** into locking position. Lock pin **44** also preferably includes a slot **45** through which may project finger gripped manipulating members **48** carried by the pin and engageable to shift the pin in the socket **44** against the action of the spring **46**.

The lower portion **30** of the housing has an inlet passage **50** which discharges into a chamber **52** separated from the interior of the housing part **30** by a wall or partition **54** but open at an arcuate passage **56** at a level below the level of the inlet passage **50** and defined by an arcuate wall **58** of approximately 45 deg. extent and located under a splash breaker flange **60** projecting circumferentially beyond the end of the wall **58** located below the level of the inlet passage **50**. A plurality of internal projections **62** are formed in the housing part **30** projecting interiorly thereof in spaced relation adjacent the outlet of the arcuate passage **56** and preferably in the form of wedges located at circumferentially and vertically spaced locations. The arcuate wall **58** is preferably characterized by a splash breaker flange **64** located spaced above the bottom of the container on the

surface of the wall 58 opposite that which defines the pasasge 56. A second and upper splash breaker flange 66 projects internally in the housing part 30 at a level spaced above the top passage defining flange 60.

An internal annular shoulder 70 is formed in the housing 26 adjacent the junction of the portions 28 and 30 thereof and supports a gasket ring 72 on which bears the marginal portion of a top disk 74 of a removable separator unit. The separator unit includes a separator wall 76 depending from the disk 74 and preferably terminating adjacent the bottom of the container portion 30. The separator wall 76 is preferably of arcuate shape in cross-section and is substantially concentric with the housing wall 30 and is spaced inwardly therefrom so as to cooperate with the container part 30 to define an arcuate flow path from a location approximately at the discharge mouth of the passage 56, as seen in FIGS. 2 and 6 to substantially diametrically opposed location in the housing 30. The separator unit is also characterized by a central opening 78 in the top disk 74 from which may be suspended a tubular open-ended member 79. A lower cup-shaped screen 80 substantially concentric with the separator wall 76 and member 79 and spaced therefrom may be carried by disk 74 with its bottom preferably terminating below the member 79 and below the level of the upper splash breaker flange 66 and above the level of the top flange 60 defining the arcuate passage 56. The disk opening 78 also preferably mounts an inverted shallow upwardly projecting cup screen 82. The separator unit consisting of the parts 74–82 are mounted in the housing bearing upon the gasket 72 and is removable to accommodate ready access to the interior of the casing when required.

A rotor unit 84, best illustrated in FIGS. 7 and 3, is preferably mounted within the tubular mounting part 28 above the separator unit. As here illustrated, the rotor unit consists of spaced parallel upper and lower disks 86 interconnected in registering parallel relation by spacers 88. Supporting legs 90 project below the lower disk 86 and are adapted to bear upon the top disk 74 of the separator unit for the purpose of spacing the rotor unit at proper elevation within the housing part 28. The disks 86 mount suitable journals or bearings 92 within which rotate the end portions of a pin 94 projecting from the hub of a vaned rotor 96 having a plurality of rotor blades close spaced circumferentially and adapted to respond to flow of air thereagainst to cause rotation thereof. As best illustrated in FIG. 7, each of the rotor plates 86 has a plurality of apertures 87 therein to provide substantially unrestricted flow of air therethrough, said apertures 87 preferably being located outwardly relative to the inverted upper cup-screen 82 of the separator unit.

A removable apertured partition disk 98 preferably fits within the housing part 28 and preferably has a central projecting lug 100 bearing upon the top of the rotor unit. A removable domed partition 102 may be supported on the disk 98 and has a central aperture within which an upwardly projecting tubular screen member 104 is mounted.

The removable cover or lid 32 is preferably provided with means for releasably locking or retaining it upon the housing 26. Thus, as best seen in FIG. 4, the inner surface of the upper housing part 28 may be provided with a bayonet slot 106 at one or a plurality of positions thereon. Each bayonet slot 106 receives a pin 108 on the lid which seats in a circumferential part of the bayonet slot when in locked position and which slides to a position aligned with a vertical part of said slot when the cover or lid is rotated through a small angle, as well understood in the art. The cover 32 is also provided with one or more inwardly projecting tubular exhaust ports 110 whose inner ends project into the mouth or open portion of the housing 28 and preferably terminate at a level below the exposed part of the tubular screen 104.

In the use of the device air bearing dust and dirt drawn into the suction unit 14 is discharged therefrom through the flexible conduit 24 to enter the housing 20 of the dust collector through the port 50 at a relatively high level compared to the level of the liquid in the container as designated by the line 112. Dirt laden air passes from inlet passage 50 into the inlet chamber 52 and thence is diverted into the arcuate passage 56 which is below the level of the inlet and also below liquid level 112 so that the air must flow through water contained in the device. The air flows through the passage 56 and emerges within the lower housing part 30 outwardly of the arcuate separator wall 76. The bottom wall of the passage 56 is preferably sloped circumferentially, as illustrated at dotted lines 57 in FIG. 3, so that any dirt and dust released by the moving air falls onto the sloping passage bottom and is propelled therealong by the agitation of the water created by passage of air therethrough. After the air is discharged from passage 56, it and liquid carried with it is free to flow upwardly into the annular space in the lower chamber part between the outer wall 30 and the separator wall 76 and past projections 62 which break up circumferential flow until it reaches a break in the separator wall at which it can flow into the separator unit through the lower cup-screen 80 and thence be discharged from the separator unit through the outlet 78 and the inverted upper screen 82. The air discharged through screen 82 then passes through the rotor unit with rotation of the rotor blades 96 resulting therefrom. Blades 96 provide a surface upon which excess moisture in the air may collect for drainage. After passing through the rotor unit air passes through the apertured plate 98 and the dome 102 and then discharges radially outwardly through the tubular screen 104 and flows downwardly to the lower inlet end of one of the tubular exhaust ports 110.

As a result of this path of flow of air through the dust collector, not only dirt particles but also dust entrained in the air drawn into the suction unit 14 is precipitated for collection within the lower part of the housing 20. The device can be cleaned of this precipitated dirt and dust periodically by removing the cover 32, the rotor unit and the separator unit and flushing the housing of collected and removed dirt. For this purpose the unit will, of course, be detached from its mounting and from the conduit 24. If desired, water may be caused to flow in the device through the inlet 34 to insure that a complete flushing job is done, although back flushing will obviously be possible as well, in which event the inlet passage 50 serves as the outlet for the back flushing operation. The various parts of the device can also be cleaned readily by immersing the same after they have been removed from the unit.

It will be understood that the number of units which are provided in the device in the nature of moisture precipitating parts, such as screens 80 and 82, the rotor unit with its rotor 96 and the top dome unit with its screen 104, may be varied according to the extent to which it is desired to remove moisture from the air discharged from the device. Thus, if the device is to be used in conjunction with a forced air warm air heating system, it may be desired to retain moisture for humidification purposes. Consequently, it will be understood that the number of screens and other moisture barriers may be reduced by simplifying the construction. One such simplified construction is illustrated in FIG. 9 wherein the rotor unit 84 is replaced by a structure having a pair of opposed spaced horizontal disks 120 connected together in selected spaced relation by spacer posts 122. In this embodiment the housing part 28 may be provided with an upper portion of a larger bore than the lower portion, thus defining a circumferential shoulder 124 upon which the lower disk 120 may bear in selected spaced relation above the separator unit and particularly the inverted upper screen 82 of said separator unit.

It will also be apparent that, where the device is used in conjunction with a system in which a large volume of air must be moved, such as in a warm air heating system, the proportions and dimensions of the parts may be varied to accommodate the service desired, and also that the unit will preferably be located at the air inlet to the heater or air conditioner as at the junction of the return air lines with the heater. The unit may be located either in advance of or behind the usual blower used in a forced air heating plant or air conditioning system.

The construction illustrated and described is particularly well suited for use with vacuum cleaners or with any other apparatus in which the dust collector is moved bodily or is subject to tilting. The air flow passage through the device is in effect a labyrinth and is so shaped, due to its location below the air intake and due to protective walls such as partitions **54** thereof, that tilting or reciprocating movement of the apparatus will not entail any substantial back flow of water, such as might enter the intake opening **50** and the connected conduit **24**.

Another characteristic of the device is that the position of the separator unit relative to the direction of air intake produces flow of air and water in a predetermined path with a double swirl action. Thus air is required to flow around the separator wall **76** or to flow within the separator **76**. In each instance there is a reversal of the direction of air flow as it passes to discharge which further serves to prevent back flow of water. Also, the circuitous flow of air occurring in the device entails back flow or change of direction of flow, for example, after passing around the separator wall **76** to enter the screen **80** and the separator outlet **78**. Other examples of change or direction of air flow are the requirement for lateral outward flow of air from the separator outlet **78** to the apertures **87** in the rotor unit, and the circumferential deflection of air by the vanes **96** of the rotor unit. Finally, convergence of air flow is produced by the dome **102** and is followed by lateral downwardly directed air flow from the screen **104** to enter the air exhaust passages **110**.

Another characteristic of the device which is particularly advantageous for its use in connection with a vacuum cleaner is that there is no likelihood of escape of entrapped dirt or dust incident to physical movement of the device, for example, incident to reciprocation during use.

While the preferred embodiments of the invention have been illustrated and described, it will be understood that changes in the construction may be made within the scope of the appended claims without departing from the spirit of the invention.

We claim:

1. A dust collector for use in conjunction with apparatus having forced circulation of air and discharge of air to atmosphere, comprising

a housing having an air inlet intermediate its height and an air outlet in its upper part,

partition means in said housing defining a circuitous passage communicating with said air inlet and discharging circumferentially in said housing,

said container being adapted to hold liquid having a level below said air inlet and outlet and above said passage discharge whereby air discharges therein,

removable means in said housing for directing air from said passage to said air outlet in a circuitous flow path, and including

removable arcuate separator means located centrally within said housing adapted to be immersed in liquid and projecting thereabove defining means directing flow circumferentially adjacent the outlet of said passage and also defining therein an inner zone into which air flows in its path to said outlet,

a plurality of vertically spaced screens in said housing between said separator means and said outlet, and

means deflecting air laterally in said housing between said screens.

2. A dust collector for use in conjunctioi with apparatus having forced circulation of air and discharge of air to atmosphere, comprising

a housing having an air inlet intermediate its height and an air outlet in its upper part,

partition means in said housing defining a circuitous passage communicating with said air inlet and discharging circumferentially in said housing,

said container being adapted to hold liquid having a level below said air inlet and outlet and above said passage discharge whereby air discharges therein,

separator means removably mounted in said housing and including

an apertured disk spanning said housing spaced above said liquid level and located between said passage and said outlet,

an arcuate deflector depending from said disk and adapted to be immersed in liquid adjacent and inwardly of said passage to circumferentially direct flow in said housing from said passage discharge and thence into a zone defined by said deflector and through said apertured disk,

a plurality of spaced screens above said apertured disk, and means deflecting air laterally between said screens.

3. A dust collector for use in conjunction with apparatus having forced circulation of air and discharge of air to atmosphere, comprising

a housing having an air inlet intermediate its height and an elongated air outlet in its upper part,

partition means in said housing defining a circuitous passage communicating with said air inlet,

said container being adapted to hold liquid having a level below said air inlet and outlet and above said passage discharge,

removable means in said housing for directing air from said passage above and to the inner end of said air outlet in a circuitous flow path,

said housing being substantially circular in cross section,

said passage extending circumferentially of said housing for at least 30° below the level of said inlet, and

a separator unit including a disk spanning said housing above the level of said passage and having a central aperture, and

a curved plate depending from said aperture with its lower portion immersed in said liquid to define an outer air and liquid flow path from the outlet of said passage to a substantially diametrically opposed location in said housing at which flow may enter the space outlined by said plate, and projections carried by said housing in said outer flow path.

4. A dust collector for use in conjunction with apparatus having forced circulation of air and discharge of air to atmosphere, comprising

a housing having an air inlet intermediate its height and an air outlet in its upper part,

partition means in said housing defining an arcuate intake passage communicating with and below the level of said inlet and discharging circumferentially,

said housing being adapted to hold liquid having a level above said intake passage and below said inlet and outlet whereby air discharges in said liquid,

a substantially arcuate separator wall positioned substantially concentrically in the lower part of said housing with its lower end immersed in liquid and around which flow air from said air intake passage and liquid propelled thereby before entering the central part of said housing, and

removable means in the upper part of said housing and located above and in communication with the space outlined by said arcuate separator wall for directing air in a circuitous path to said outlet and including a

plurality of spaced screens and means between said screens for laterally deflecting air flow.

5. A dust collector for use in conjunction with apparatus having forced circulation of air and discharge of air to atmosphere, comprising

a housing having an air inlet intermediate its height and an air outlet in its upper part,

partition means in said housing defining an arcuate intake passage communicating with and below the level of said inlet and discharging circumferentially,

said housing being adapted to hold liquid having a level above said intake passage and below said inlet and outlet,

a substantially arcuate separator wall positioned substantially concentrically in the lower part of said housing around which flow air from said air intake passage and liquid propelled by the air before entering the central part of said housing,

removable means in the upper part of said housing and located above and in communication with the space outlined by said arcuate separator wall for directing air in a circuitous path in said outlet, and

internal projections in said housing above liquid level adjacent said separator wall to break up circumferential flow of air and water around said separator wall, said air directing means including vertically spaced screens and means between said screens for laterally deflecting air.

6. A dust collector for use in conjunction with apparatus having forced circulation of air and discharge of air to atmosphere, comprising

a housing having an air inlet intermediate its height and an elongated air outlet in its upper part,

partition means in said housing defining an arcuate intake passage communicating with and below the level of said inlet and discharging circumferentially,

said housing being adapted to hold liquid having a level above said intake passage and below said inlet and outlet,

a substantially arcuate separator wall positioned substantially concentrically in the lower part of said housing around which flow air from said air intake passage and liquid propelled thereby before entering the central part of said housing,

removable means in the upper part of said housing and located above and in communication with the space outlined by said arcuate separator wall for directing air in a circuitous path to said outlet,

means in said housing above liquid level and around said separator wall for breaking up circumferential flow of liquid around said separator wall, and

an arcuate circumferentially extending splash breaker flange spaced above said last named means said air directing means including an apertured partition having a flow passage extending above the level of the inner end of said outlet.

7. A dust collector for use in conjunction with apparatus having forced circulation of air and discharge of air to atmosphere, comprising

a housing having an air inlet intermediate its height and an air outlet in its upper part,

partition means in said housing defining an arcuate intake passage communicating with and below the level of said inlet and discharging circumferentially

said housing being adapted to hold liquid having a level above said intake passage and below said inlet and outlet,

a substantially arcuate separator wall positioned substantially concentrically in the lower part of said housing around which flow air from said air intake passage and liquid propelled thereby before entering the central part of said housing,

removable means in the upper part of said housing including a plurality of spaced screens and deflecting means therebetween located above and in communication with the space outlined by said arcuate separator wall for directing air in a circuitous path through said screens to said outlet, and

an arcuate circumferential splash breaker flange carried by said partition means and between the same and said separator wall.

8. A dust collector for use in connection with apparatus having forced circulation of air and discharge of air to atmosphere, comprising

a housing having an air inlet intermediate its height and an air outlet in its upper part,

partition means in said housing defining an arcuate intake passage communicating with and below the level of said inlet and discharging circumferentially,

said housing containing liquid having a level above said arcuate intake passage and below said inlet and outlet,

an annular member spanning said housing above said intake passage,

a substantially arcuate separator wall of less than 360° suspended from said annular member and positioned substantially concentrically in the lower part of said housing around which flow air from said air intake passage and liquid propelled by the air before entering said separator wall and passing through said annular member,

removable means in the upper part of said housing and located above and in communication with the space outlined by said arcuate separator wall for directing air in a circuitous path to said outlet,

said air-directing means including spaced screens and intervening means for laterally deflecting air flow between and through said screens,

said housing having an enlarged bulbous lower portion receiving said separator wall and tapering upwardly and downwardly from its portion of greatest cross-sectional size said liquid level being located adjacent the portion of the housing of greatest cross-sectional size.

9. A dust collector for use in conjunction with apparatus having forced circulation of air and discharge of air to atmosphere, comprising

a housing having an enlarged bulbous lower part, an air inlet intermediate its height and an air outlet in its upper part,

an arcuate vertical separator wall substantially centrally positioned in said enlarged lower housing part to define an arcuate outer chamber and an inner chamber,

means in said housing communicating with said inlet and defining an intake passage below the level of said inlet and discharging circumferentially into said arcuate outer chamber,

said housing being adapted to hold liquid at a level adjacent the greatest cross-sectional size of said housing and above said intake passage and below the upper portion of said separator wall, and

means directing air from said inner chamber to said outlet in a circuitous path and including vertically spaced screens and means between said screens for deflecting air laterally in said housing.

10. A dust collector for use in conjunction with apparatus having forced circulation of air and discharge of air to atmosphere, comprising

a housing having an enlarged lower part, an air inlet intermediate its height and an elongated air outlet in its upper part,

an arcuate vertical separator wall substantially centrally positioned in said enlarged lower housing part to define an arcuate outer chamber and an inner chamber,

means in said housing communicating with said inlet and defining an intake passage below the level of said inlet and discharging circumferentially into said arcuate outer chamber,

said housing being adapted to hold liquid at a level

above said intake passage and below the upper portion of said separator wall,

means directing air from said inner chamber to said outlet in a circuitous path for discharging air laterally of and above the level of the inner end of said outlet, and

projection in said arcuate outer chamber above liquid level.

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