Nov. 3, 1936. J. E. WATSON 2,059,673

SEPARATOR

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Fig. 1.

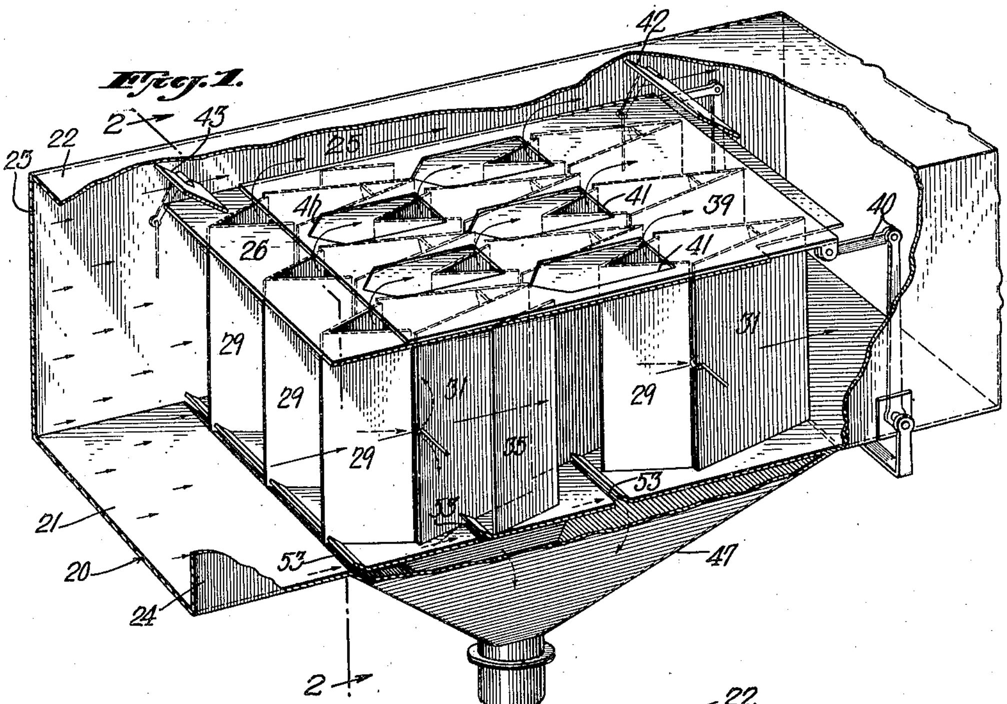


Fig. 2.

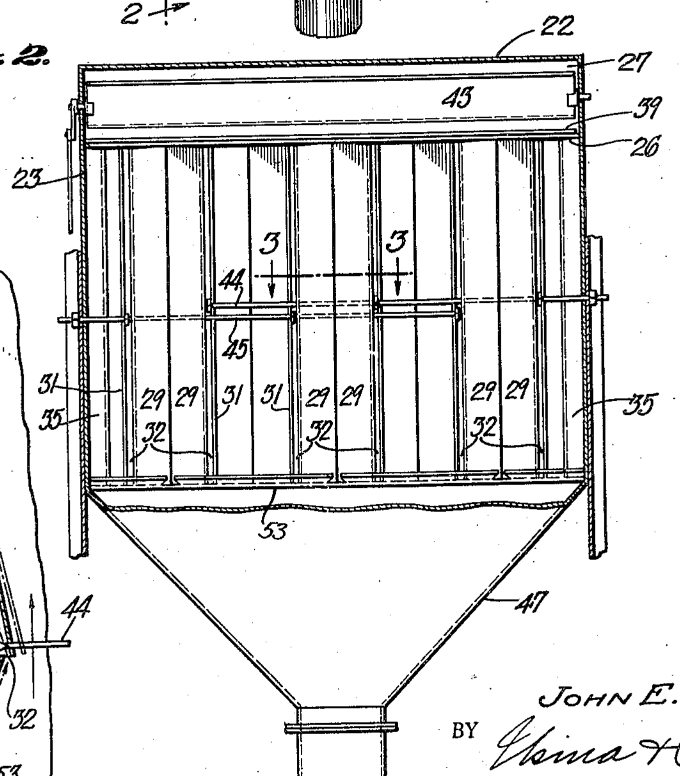
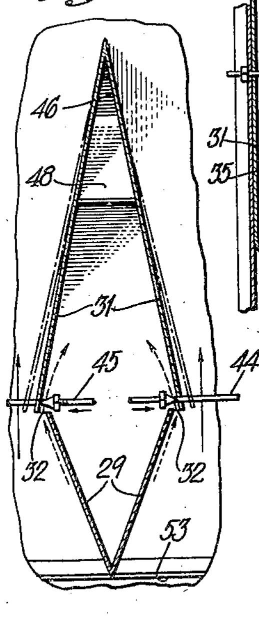


Fig. 3.



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ATTORNEYS

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Fig. 4.

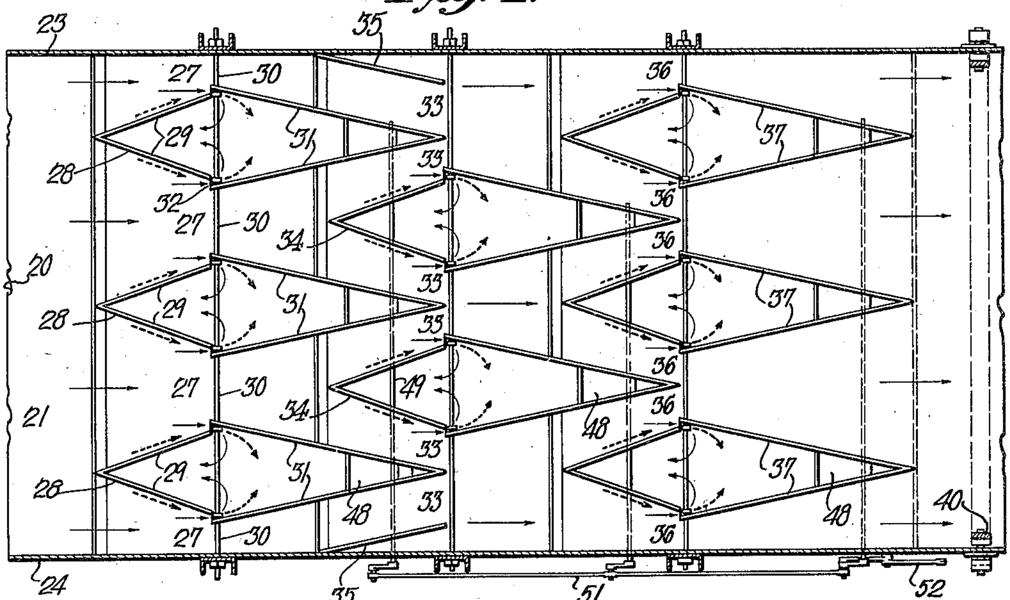
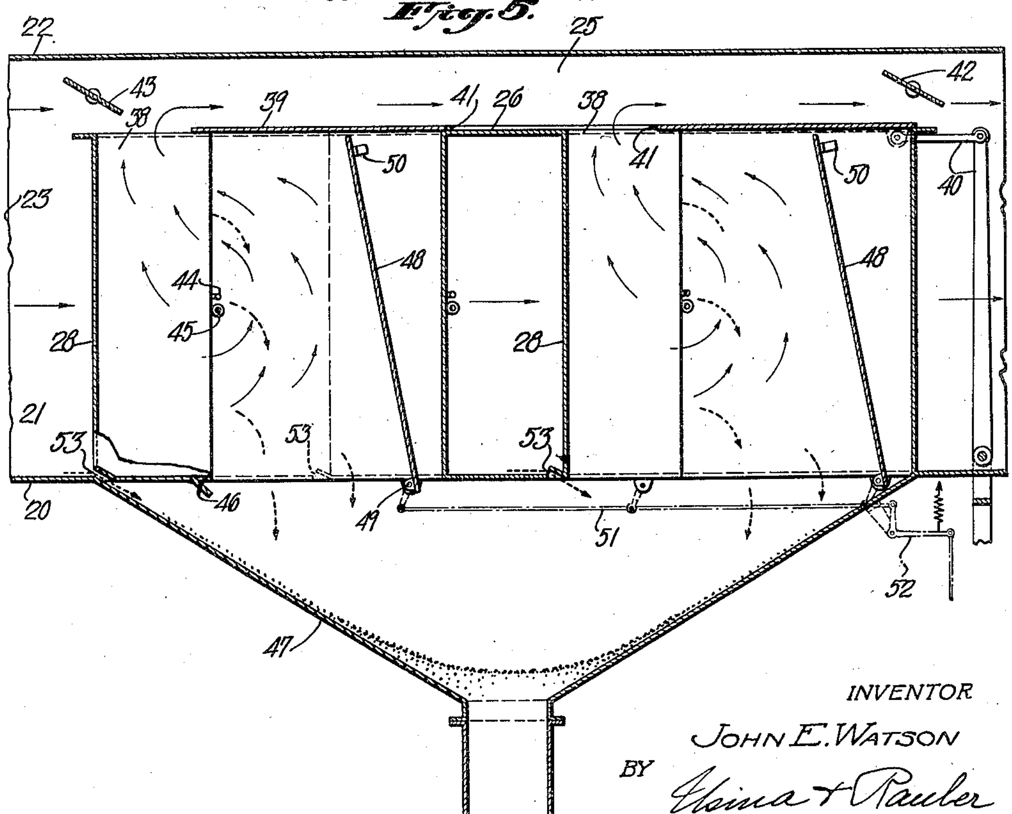


Fig. 5.



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BY [signature]

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SEPARATOR

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Fig. 6.

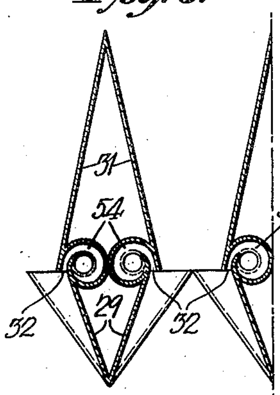

Fig. 7.

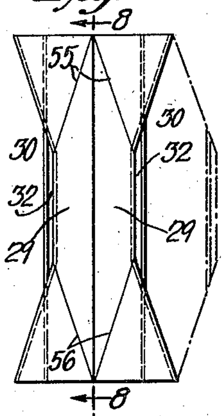

Fig. 8.

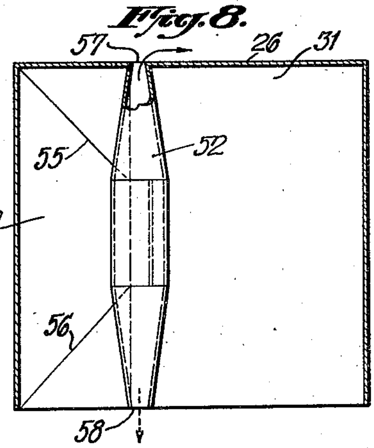

Fig. 9.

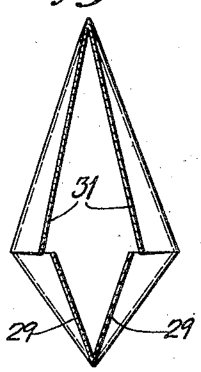

Fig. 10.

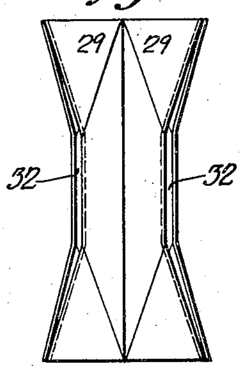

Fig. 11.

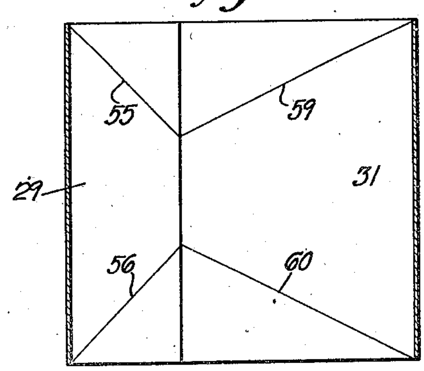

Fig. 12.

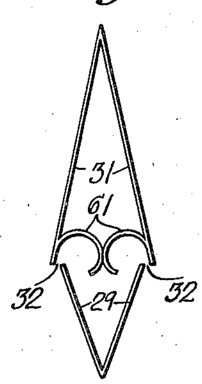

Fig. 13.

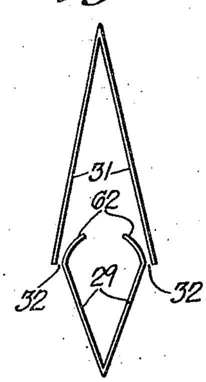

Fig. 14.

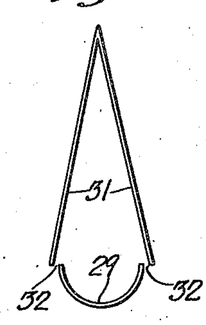

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Fig. 15.

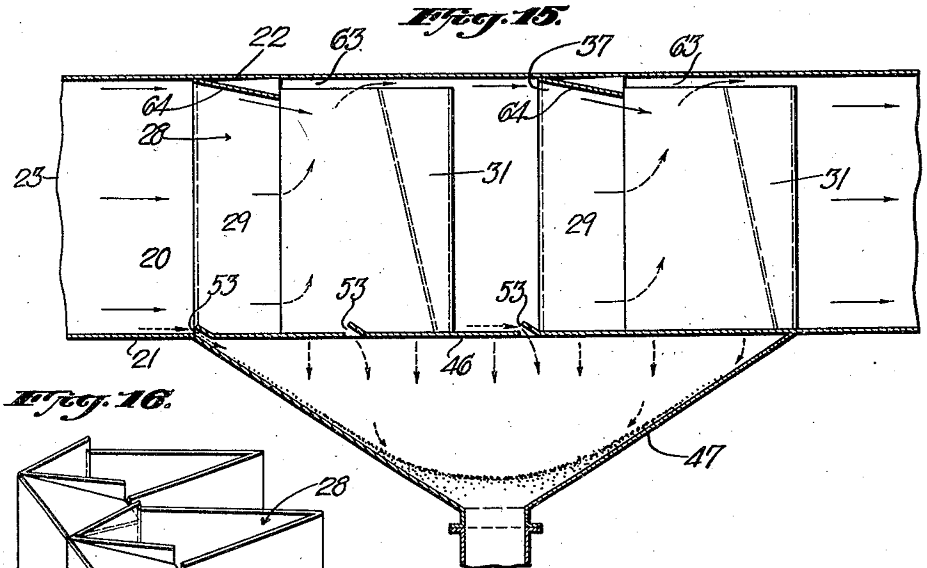


Fig. 16.

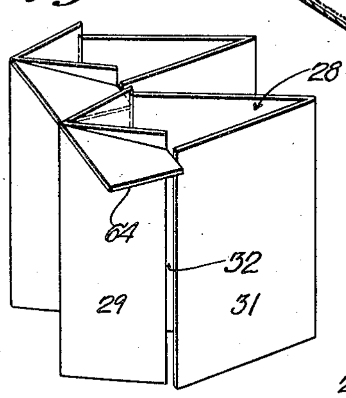
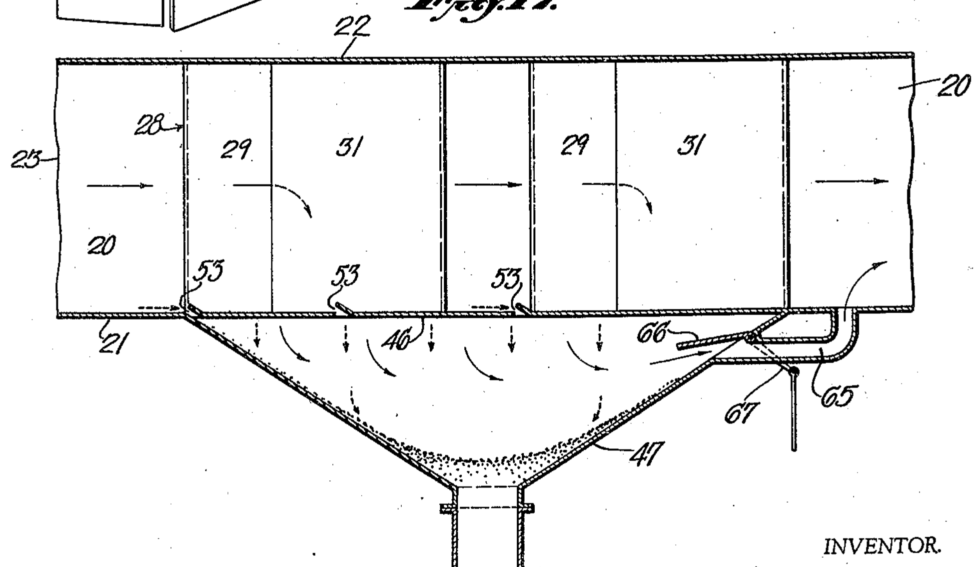


Fig. 17.



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Patented Nov. 3, 1936

2,059,673

UNITED STATES PATENT OFFICE

2,059,673

SEPARATOR

John E. Watson, New Rochelle, N. Y., assignor to Prat-Daniel Corporation, New York, N. Y., a corporation of New York

Application March 18, 1935, Serial No. 11,534

15 Claims. (Cl. 183—110)

My invention relates to apparatus for collecting the suspended particles such as dust, soot, fumes, powdered substances and materials of like nature from flowing masses of gases or air.

Heretofore certain types of dust collectors have provided baffles or baffle devices whereby the passage of the gas or air has been suddenly stopped or arrested or changed either locally or throughout in order to decrease the carrying effect of the gas and to permit the suspended particles to settle downwardly out of the gaseous current. The separation of the suspended particles in this manner is, however, imperfect and inefficient because the arrested volume of gas must again re-enter the gas stream and in doing so carries or sweeps some of the dust with it or creates eddy currents that maintain the particles in suspension and carry them back into the gas stream. Moreover, the sudden arresting of the gas streams dissipates the kinetic energy of the flowing gases and imposes an undesirable resistance to the passage of the gas or air.

My present invention avoids these various disadvantages and provides an apparatus in which the current or stream of gas is not sharply arrested but in which the suspended particles are concentrated in a smaller or limited stratum or strata of the air or gas which is then removed or temporarily arrested to permit the separation of the particles.

The various features of the invention are illustrated in the accompanying drawings in which—

Fig. 1 is a perspective view of an apparatus embodying a preferred form of the invention, certain parts being omitted to show the interior construction; Fig. 2 is a vertical sectional view of the apparatus taken on the plane 2—2 of Fig. 1; Fig. 3 is a detail horizontal section taken on the line 3—3 of Fig. 2; Fig. 4 is a horizontal section through the air passages; Fig. 5 is a longitudinal vertical section taken at right angles to the section of Fig. 2; Fig. 6 is a horizontal section taken on a plane similar to that of Fig. 3 of a modified form of dust collecting and separator device; Figs. 7 and 8 are respectively front and longitudinal views of a modified form of dust collecting elements, Fig. 8 being taken on line 8—8 of Fig. 7; Fig. 9 is a horizontal section of another modification of the dust collecting device; Figs. 10 and 11 are respectively front and longitudinal views of the modification shown in Fig. 9; Figs. 12, 13 and 14 are plan views of various modifications of dust collecting elements; Fig. 15 is a longitudinal view of a dust collector or separator embodying still further modifications and features of the invention; Fig. 16 is a perspective view of certain dust collecting elements of the modification shown in Fig. 15; and Fig. 17 is a longitudinal sectional view of a still further modification showing an outlet to the main passage from the dust collecting bin or hopper.

In my invention a stream or current of dust laden or particle carrying air or gas is passed through a passage or passages having converging walls or dimensions. The air immediately adjacent these converging walls is deflected, whereas the momentum of the particles tends to concentrate them toward the converging wall surfaces. A slot is provided to intercept the layer of air that has passed along the converging wall and to deflect this layer of air back of the wall into a quiet zone from which the particles of dust may settle. The air thus trapped may be then again admitted to the air current or stream. After passing the slots the air enters a diverging passage, the general effect of the converging and diverging passages being similar to that of a Venturi passage in which the velocity is increased without eddy currents in passing through the narrow portion and gradually decreased after passing the latter. After passing through one such venturi the gas may then be passed through successive ones, the arrangement being preferably such that the passages are divided beyond the venturi or throat part so that the gas stream passing centrally through the throat of one passage is brought adjacent the converging wall of the next passage and thus its dust or particle content is brought adjacent to the separating wall and collecting slot. In passing through the several passages, therefore, the air or gas is not abruptly changed or stopped or baffled but merely passes through Venturi passages in which it is slightly deflected to concentrate the suspended particles where they may be most readily separated and collected.

Various forms of converging and diverging passages may be employed to suit particular conditions, such as the size and weight of particles and the condition and pressure of the gas. In general, however, the construction and arrangement of the passages is such as to obtain the most effective deflection of the particles toward the slotted wall or edge of the passage and with the most effective streamlining or air flow for the gases after passing the throat of each passage.

A quantity of air will be entrapped with the particles separated in the intercepting slots of the passage. This gas is received in separating chambers which may conveniently be formed back of the converging walls and in these separating chambers the particles fall through the substantially quiescent air or gas while the latter gradually rises and is withdrawn through passages or returned to the main air current. The flow of this returning gas or air may be suitably controlled to control the velocities or flow within the settling chambers and thus permit a separation of the suspended particles. The size of the slots may also be adjusted to obtain the maximum separation of dust particles for a minimum quantity of deflected air or gas. The air received from one throat may also be returned directly to the air passage after being freed from the suspended dust particles and thus again subjected to the separating action in a subsequent passage or it may be by-passed entirely through the remainder of the apparatus.

Referring more particularly to Figs. 1 to 5 of the accompanying drawings, a stream or current of particle carrying air or gas is passed as indicated by the arrows in Figs. 1, 4 and 5 through a wind box or tunnel **20**. The wind box or tunnel **20** may be of any suitable form. In the form shown in Figs. 1 to 5 it has a bottom **21**, a top wall **22** and side walls **23** and **24**. In the particular form shown in Figs. 1 to 5 a by-pass **25** is formed by means of a horizontal partition wall **26** in the upper part of the tunnel or box. The tunnel below the partition **26** is divided into separate passages **27** by means of a series of spaced chambers **28** that extend from the bottom wall **21** to the partition wall **26**. The chambers **28** have diverging front walls **29** so that the forward or entrance part of the passages **27** converge to a throat area or zone **30**. This converging of the passages **27** will tend to deflect the air stream from the outer walls while the momentum of the particles will tend to concentrate them along the outer surfaces of the walls as indicated by the broken arrows in Fig. 4. The rear part of the chambers **28** extending back from the throat **30** have walls **31** that converge to a rearwardly extending point so as to cause the passages **27** to expand rearwardly from the throat **30** giving a streamline effect which will prevent the formation of eddy currents after passing the throat **30**. The air currents, therefore, are deflected to concentrate the suspended particles adjacent the walls of the passages without any sharp change of direction or baffling effect that would create eddy currents.

The front edges of the walls **31** are spaced somewhat wider than the rear edges of the walls **29** so as to overlap the latter and provide narrow slots **32**, indicated on a larger scale in Fig. 3 through which the heavy dust laden air adjacent the wall **29** passes into the interior of the chambers **28** and is thus separated from the main current of air.

After passing through the passages **27** the current of air in each passage is divided and deflected into subsequent passages **33** by means of a second series of collecting chambers **34** similar to the chambers **28**. Side plates **35** are provided for the outermost passages so that the passages **33** will have the desired converging shape. In passing through the passages **33** the air or gas current will again be subjected to the same influence that prevailed in the passages **27**. As the chambers **34** are in staggered relation to the chambers **28**, the air passing through the central part of the cross-sectional area of the passages **27** is now brought into the closest contact with the front walls of the chambers **34** and therefore subjected to the direct concentrating action of these deflecting walls. It will be apparent that in this manner the central part of the air passing through the passage **27** will be directed against the full surface of the front walls of the subsequent chambers **34**.

After passing through the passages **33** the gases may be brought into passages **36** formed between the walls and a third series of chambers **37** and the series of chambers may be repeated, if necessary, until the required particles have been separated from the gas stream.

The chambers **28**, **34** and **37** open upwardly into the by-pass conduit **25** which in turn communicates at its exhaust end with the main current of purified gas or air past the last of the chambers. As there is a direct unobstructed flow through the conduit **25** the air or gas that has entered chambers **28**, **34** and **37** passes upwardly through openings **38** into conduit **25** and thus rejoins the purified air current. The amount of air that is drawn in through the slots **32** and thence through the chambers and openings **38** into the conduit **25** may be regulated by means of a sliding plate **39** slidable on top of the partition **26** by means of an actuating lever mechanism **40** to open or close the passages **38** to a greater or less extent and thus control the upward flow of air. Individual plates may be provided in this manner for the several chambers or several of them may be controlled by a single apparatus **39** having damper openings **41** provided therein to overlap the openings **38** to a greater or less extent depending upon the position of the apparatus **39**. The quantity or rate of flow of air into and through the chambers **28**, **34** and **37** may be further controlled by means of a damper **42** at the rear of the conduit **25** and a damper **43** at the front end of the conduit. The damper **43** will ordinarily be closed to prevent by-passing of too large a quantity of air or gas about the purifying conduit or box. The damper **42** may be tilted to control the resistance to flow through the conduit **25** and thus retard the flow of air or gas that may be required.

The entrance of air into the chambers **28**, **34** and **37** may also be controlled by controlling the width or cross-sectional area of the slots **32**. For this purpose the front ends of the back walls **31** are so mounted that they may be bent outwardly to the positions indicated in broken lines in Fig. 3, for example. This may be accomplished by a pair of control rods **44** and **45**, Fig. 2, one of which **44** acts upon the port wall and the other **45** acts upon the starboard. It will be understood that a pair of such rods **44** and **45** may be provided for each successive series of chambers.

The flow of the air after passing through the slots **32** into the respective chambers **28**, **34** and **37** is arrested, thereby lowering its dust carrying or buoyant effect and permitting the suspended particles to drop downwardly through openings **46** in the bottom wall **21** into a collecting hopper **47**. To prevent the accumulation of dust at the relatively narrow stern end of the chambers an inclined plate **48** may be provided for each chamber and supported between a rock shaft **49** on which it is secured at its lower end and a stop **50** at its upper end. Dust that accumulates on the plate **48** may be shaken therefrom by rocking the shaft **49**. For this purpose a connecting linkage **51** is provided and is actuated through a bell crank lever 52 from any suitable source.

Some particles may settle from the air stream in passing through the tunnel or wind box between the chambers 28, 34 and 37, that is, in passing through the passages 30, 33 and 36. Particles that thus separate will gradually be swept along the floor or bottom plate 21 and may be intercepted and directed into the hopper 47 by intercepting slots 53 in the floor or bottom plate 21.

As indicated in Figs. 6 to 14 inclusive the shape and structure of the dust collecting chambers 28, 34 and 37 may be modified or varied to suit various conditions. In the form shown in Fig. 6, for example, the slots 32 may lead into involute or scroll-shaped chambers or passages 54 which have a cyclone effect to aid the separation of the dust particles. Although in this case, the space back of the scroll walls does not receive dust laden air or function to separate the dust or particles, the walls 31 are retained to preserve the streamlining or air flow effect and to avoid eddy currents.

In the form shown in Figs. 7 and 8 the front walls 29 are bent outwardly into the passages 30 as at 55 and 56 to narrow the passages 30 at the upper and lower ends and to deflect the dust and air particles downwardly and upwardly respectively toward the mid-level and thus to concentrate the dust particles toward the mid-part of the wind box. The dust particles thus concentrated at this point are drawn into the slots 32 and into the respective chambers 28, 34 and 37. In the event that the scroll or involute type of slot is used this will have the form indicated in Fig. 8 with openings 57 and 58 for the purified air and the separated particles respectively.

In Figs. 9, 10 and 11 the bent front or prow wall construction of Figs. 6, 7 and 8 is provided, but the slots 32 are so constructed as to extend throughout the full height of these walls being graduated in thickness from a minimum at the top and bottom to a maximum at the mid-portion. In this case the rear wall must also be bent along the lines 59 and 60 to conform to the shape required for producing the slots 32.

Fig. 12 shows a chamber having incomplete involute or scroll walls 61 to receive the air entering through the slots 32 to provide a cyclone effect in addition to the settling effect of the chamber. Fig. 13 has the prow or front walls 29 extended and curved inwardly at 62 so as to give a progressively widening passage into the interior of the chamber and thus prevent sudden expansions and changes in direction and the resulting eddying effects. In the embodiment shown in Fig. 14 the front wall 29 is made of a curved shape convex outwardly so as to provide a teardrop shape to the chamber as a whole. The rear or stern walls 31 slightly overlap the edges of the wall 29 to form the entrance slots 32.

The choice of particular embodiment will depend upon operating conditions, such as the fineness or coarseness of the dust or its particular character and density and that of the gases or air.

In the embodiment shown in Figs. 15 and 16 the by-pass conduit 25 is omitted and the gas entering one set or series of chambers 28 exhausts back directly into the main gas stream within the chamber or wind box 20 and is brought into contact with a second chamber 37. For this purpose the stern or rear walls 31 do not extend the full height of the chamber 20 but are sufficiently short to leave a small by-pass slot 63 between the upper edge of the walls 31 and the top wall 22. Downwardly inclined deflecting plates 64 are provided immediately in advance of the front edges of the walls 31 and extending in a downwardly inclined direction from a distance in advance of the front edges of the walls 31 so as to throw the air current below the upper edge of the rear walls 31. The pressure outside the walls 31 is somewhat less than that of the gas approaching the slots 32 and consequently air will be drawn through the slots 32 into the chambers 28, 34 and 37 and hence flow slowly upwardly and outwardly through the passages or slots 63. The suspended particles will thus be permitted to drop downwardly through the chambers 28, 34 and 37 directly into the hopper 47. The apparatus may be otherwise the same as in Figs. 1 to 5.

In some cases it may be desirable to create a slight draft downwardly into the hopper 47 and for this purpose a by-pass pipe 65 may be provided between the upper part of the hopper 47 and the rear or exhaust end of the wind box or tunnel 20 so that a small current of air may flow downwardly into the hopper 47 and thence through the passage 65 into the purified air or gas stream. The quantity of air thus drawn into the conduit 65 may be controlled by means of a damper 66 and the crank 67.

Through the above invention therefore I have provided a method and apparatus for separating suspended particles from gas or air currents in which they are carried with a minimum obstruction of the flow of the gas or air and without interrupting or baffling the main current of air and therefore without causing substantial eddy currents. By concentrating the dust particles in strata of air that may be then removed and from which the particles may readily separate the separation is accomplished most efficiently and effectively.

What I claim is—

1. Apparatus for separating suspended particles from a gaseous current which comprises a tunnel through which said gaseous current may pass, vertical transverse chambers extending through said tunnel to divide said tunnel into passages between said chambers that decrease to a minimum and then diverge, and vertical slots in the walls of said chambers at the minimum area of said passages opening forwardly to receive gases passing along the exterior walls of said chambers.

2. Apparatus for separating suspended particles from a gaseous current which comprises a tunnel through which said current flows, transversely spaced chambers extending vertically from the bottom to the top of said tunnel and having walls that gradually diverge sidewise and then converge to form spaced passages between said chambers decreasing to a minimum and then widening, the walls of said chambers having vertical slots at the minimum area of said passages to intercept air passing adjacent the walls thereof and deflect it into said chambers, said chambers being open at the top for the escape of air received therein, and means to receive particles separated in said chambers.

3. Apparatus for separating suspended particles from a gaseous current which comprises a tunnel through which said current flows, transversely spaced chambers extending vertically from the bottom toward the top of said tunnel

and having walls that gradually diverge sidewise and then converge to form spaced passages between said chambers decreasing to a minimum and then widening, the walls of said chambers having vertical slots at the minimum area of said passages to intercept air passing adjacent the walls thereof and deflect it into said chambers, said chambers being open at the top for the escape of air received therein, means to receive particles separated in said chambers, and a conduit to receive gases exhausted through the upper openings from said chambers.

4. Apparatus for separating suspended particles from a gaseous current which comprises a tunnel through which said current passes, transversely spaced collecting chambers extending from the bottom to the top of said tunnel, said chambers expanding transversely to a maximum and then gradually contracting, the walls of said chambers extending rearwardly of said widest portion slightly spaced from and overlapping at said widest portion the walls extending forwardly thereof to form forwardly opening slots, said chambers forming air passages between said chambers that gradually decrease to a minimum and then increase, and means to remove separately separated particles and gases from said chambers.

5. The apparatus of claim 4 in which the front walls of said chambers are rounded to form a chamber having a teardrop shape in plan view.

6. The apparatus of claim 4 in which said chambers have involute passages into which said slots open.

7. The apparatus of claim 4 in which said chambers have vertical inner chambers of involute form opening at the top and bottom and into which said slots open.

8. The apparatus of claim 4 in which said chambers are widened at the top and bottom to decrease the passages therebetween transversely at top and bottom.

9. The apparatus of claim 4 in which said chambers have an upwardly and forwardly inclined plate within the stern end thereof.

10. Apparatus for separating suspended particles from a gaseous current which comprises a tunnel through which said current passes, transversely spaced collecting chambers extending from the bottom toward the top of said tunnel, said chambers expanding transversely to a maximum and then gradually contracting, the walls of said chambers extending rearwardly of the widest part thereof slightly spaced from and overlapping at said widest portion from the walls extending forwardly thereof, said chambers forming air passages between said passages that gradually decrease to a minimum and then increase, means to remove separately separated particles and gases from said chambers, a conduit to receive gases delivered upwardly from said chamber, and dampers controlling the passage of gases through said conduit.

11. Apparatus for separating suspended particles from a gaseous current which comprises a tunnel through which said current may pass, chambers spaced transversely of said tunnel and extending from the bottom toward the top thereof to form passages therebetween, said chambers having front walls that diverge to a maximum and rear walls that converge from said maximum and overlap said front walls to form slots whereby said passages between said chambers decrease to a minimum and thereafter expand, openings being formed between said rear walls of said chambers and the top of said tunnel to permit the escape of gases from said chambers, and deflecting plates extending downwardly from the top of said tunnel in advance of the rear walls of said chambers to deflect gas below the level of said openings.

12. Apparatus for separating suspended particles from a gaseous current which comprises a tunnel through which said current may pass, chambers transversely spaced in said tunnel and extending from the top to the bottom thereof to form passages therebetween, said chambers having front walls that diverge to a maximum and rear walls that converge from overlapping relation to the rear edges of said front walls whereby said passages contract to a minimum and thereafter expand and whereby entrance slots are formed into said chambers from the minimum area of said passages, and means to deflect the front edges of said rear walls of said chambers to control the width of said slots.

13. Apparatus for separating suspended particles from a gaseous current which comprises a tunnel through which said gas may pass, chambers transversely spaced in said tunnel to divide said tunnel into transversely spaced passages, said chambers widening to a maximum and then decreasing to decrease the cross sectional area of said passages to a minimum and then increase said cross sectional passage areas, said chambers having slots to receive gases from said passages at the minimum area thereof, and a dust collecting space below said tunnel, said chambers having openings into said space and a by-pass passage from said dust collecting space to said tunnel beyond said chambers.

14. Apparatus for separating suspended particles from a gaseous current which comprises a tunnel, chambers spaced transversely in said tunnel to form transverse passages therebetween, said chambers expanding transversely and then contracting to cause said passages to contract to a minimum and then expand, said chambers having slots to receive gases from said passages at the minimum thereof, and slots in the floor of said tunnel opening upwardly and forwardly to intercept dust laden gases from the floor of said tunnel.

15. Apparatus for separating suspended particles from a gaseous current which comprises a tunnel for the passage of said current, chambers extending from the top to the bottom of said tunnel, said chambers being arranged in successive rows and spaced transversely in said rows so that the chambers of one row are staggered with relation to those of the other row, said chambers forming passages therebetween in said tunnel, said chambers expanding transversely to a maximum and then contracting to cause the passages therebetween to contract to a minimum and then expand, and slots in said chambers to receive gases from the sides of said passages at their minimum cross sectional area.

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