United States Patent

Janich

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[54] AIR SIFTER

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June 19, 1968 Germany ..... P 17 57 819.7

[52] **U.S. Cl.** ..... **209/139 A**

[51] **Int. Cl.** **B07b 7/10**

[58] **Field of Search** 209/144, 133, 138, 139, 142, 209/148, 150, 151, 259, 409

[56] **References Cited**

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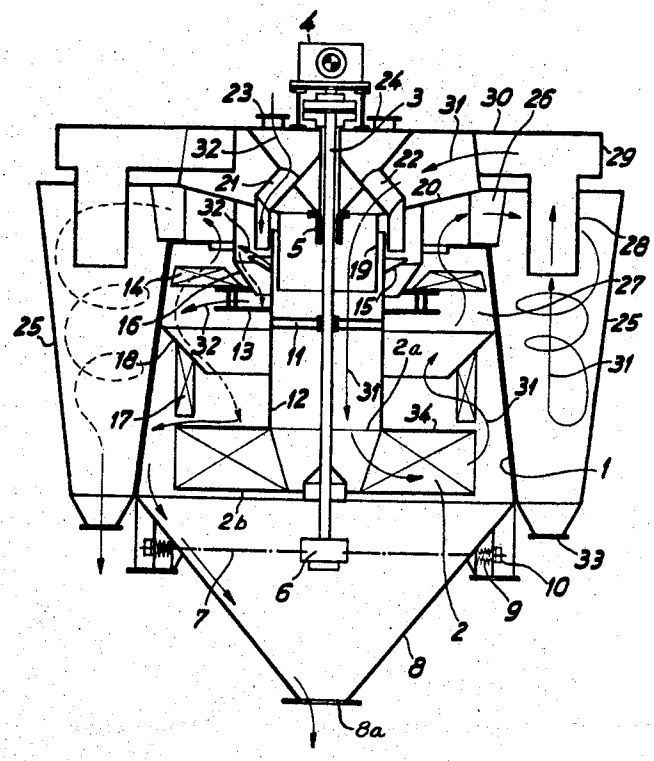
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Primary Examiner—Frank W. Lutter
Assistant Examiner—William Cuchlinski, Jr.
Attorney—Marshall & Yeasting

[57] **ABSTRACT**

An air sifter is arranged in a sifter housing, and a fan for supplying air to the air sifter is disposed in the bottom of the sifter housing. A plurality of dust separators are arranged in crown fashion around the sifter housing. Each duct separator has an inlet connected to the upper portion of the sifter housing to receive air laden with fines discharged from the sifter housing, and has an outlet connected to supply clean air to the fan.

14 Claims, 6 Drawing Figures



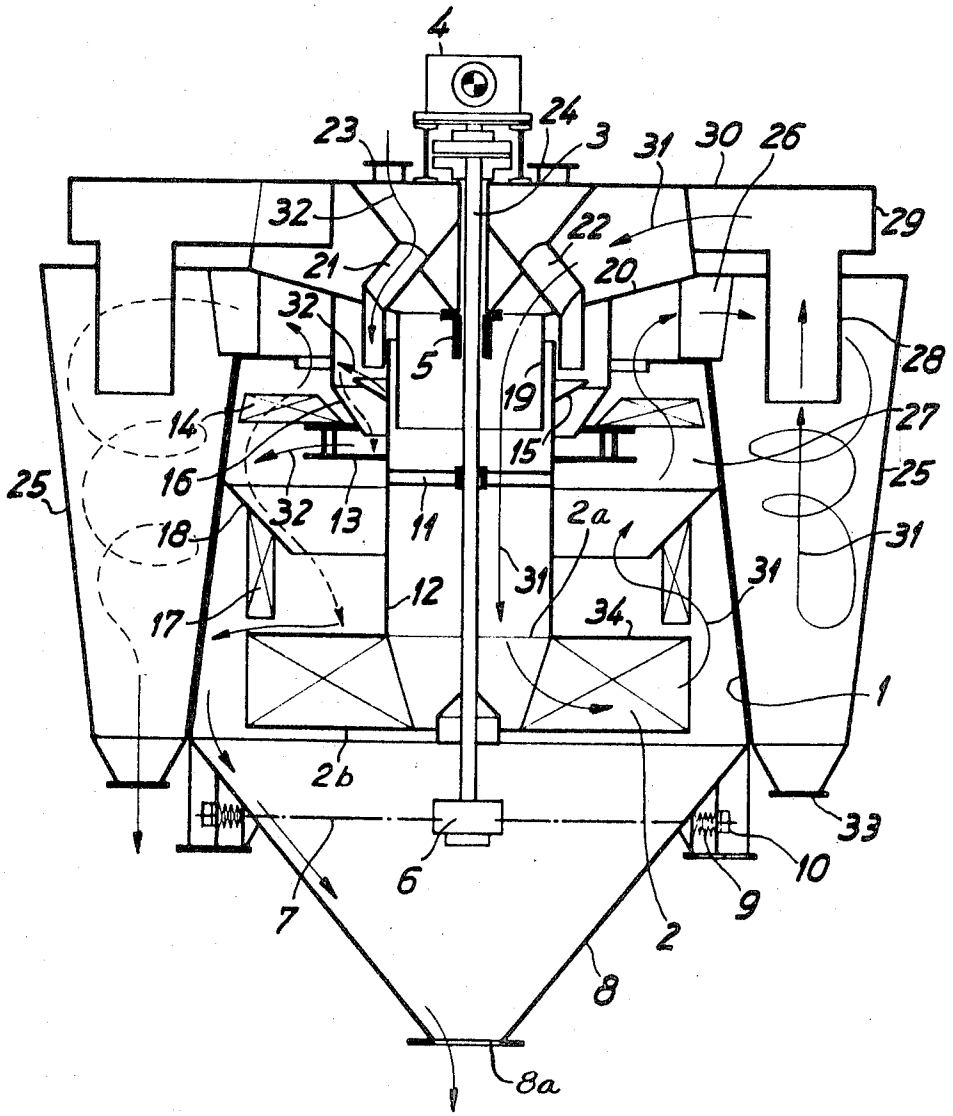

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Fig.1

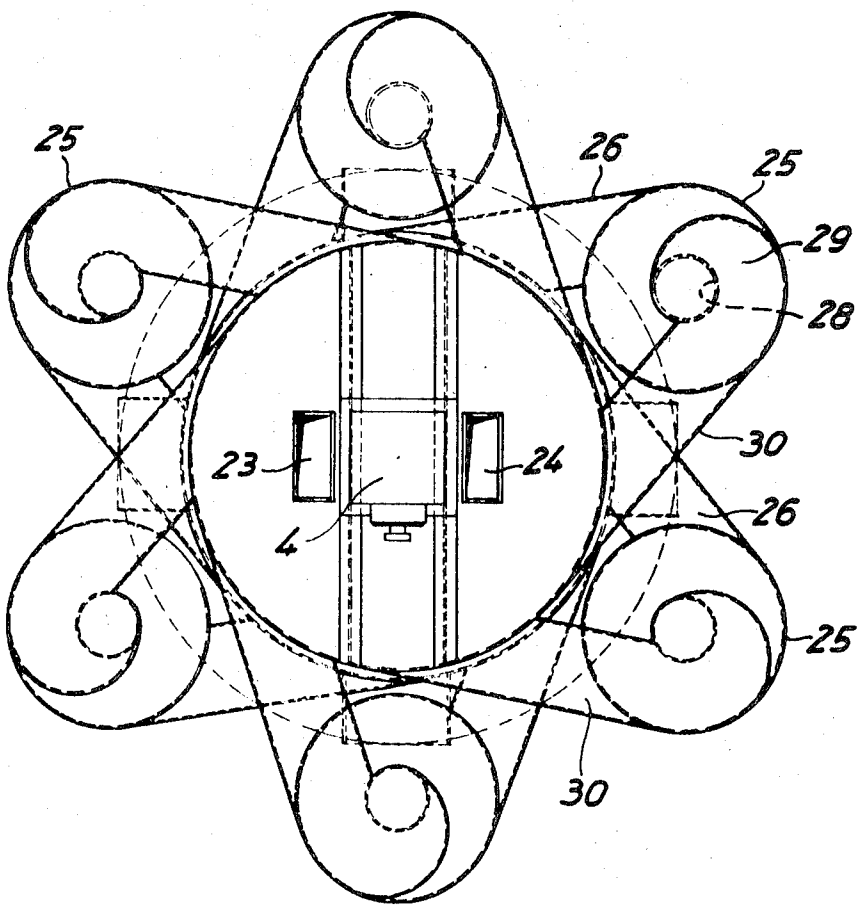


Fig. 2

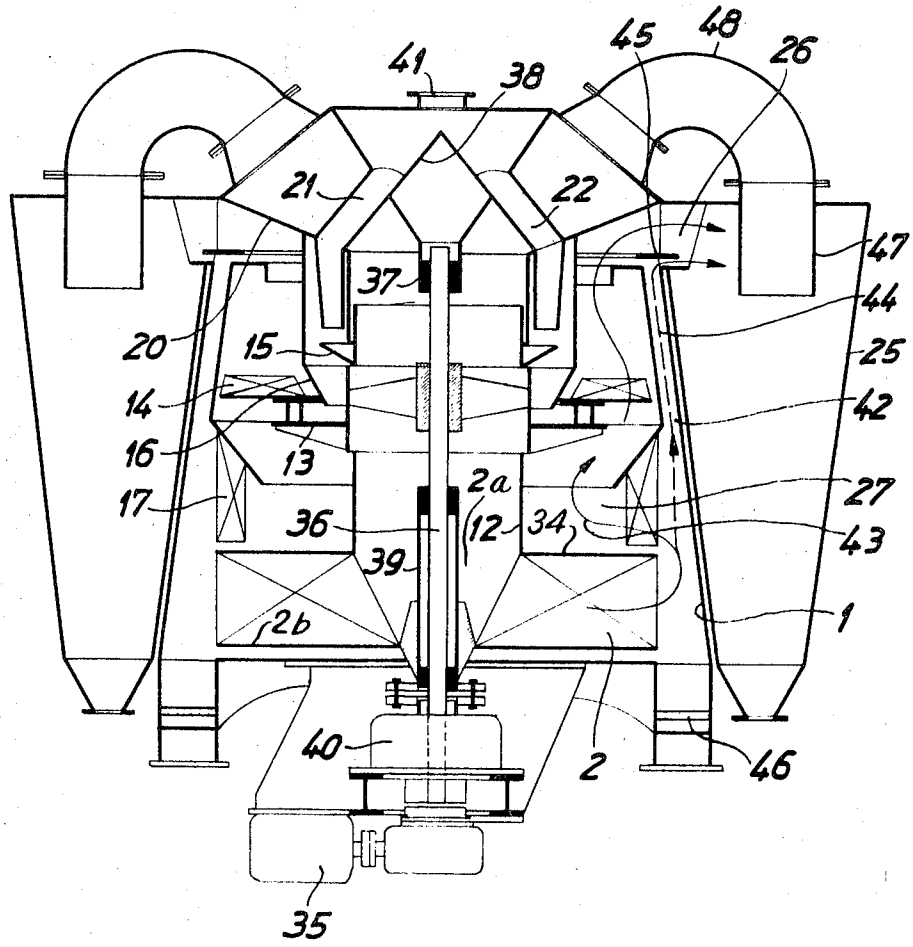

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Fig. 3

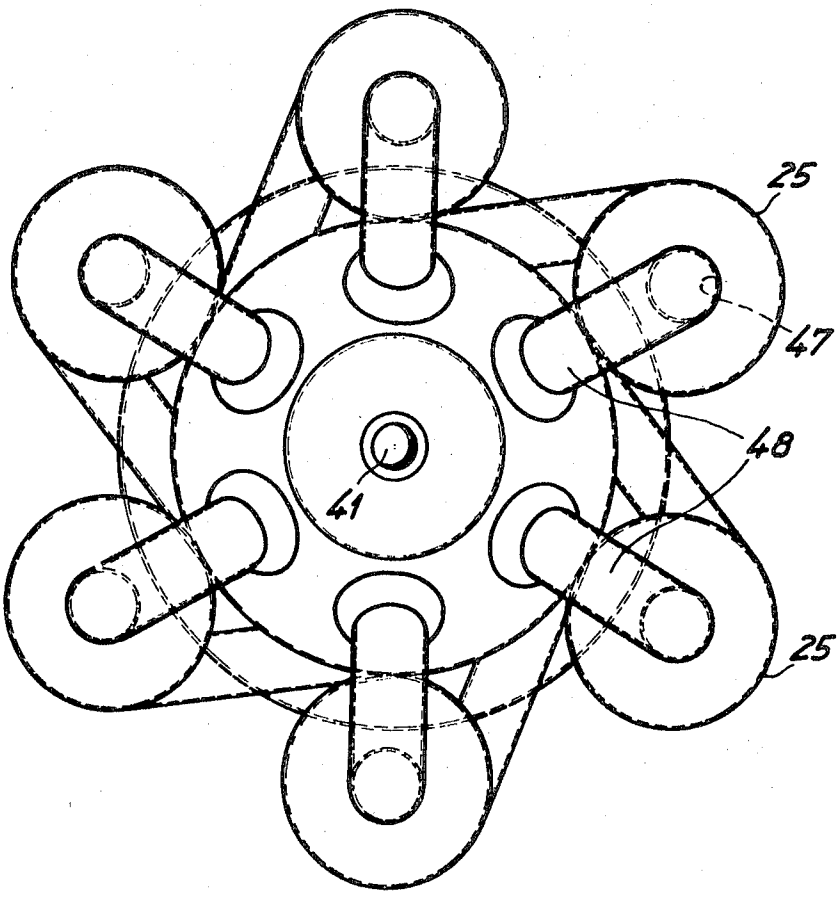


Fig.4

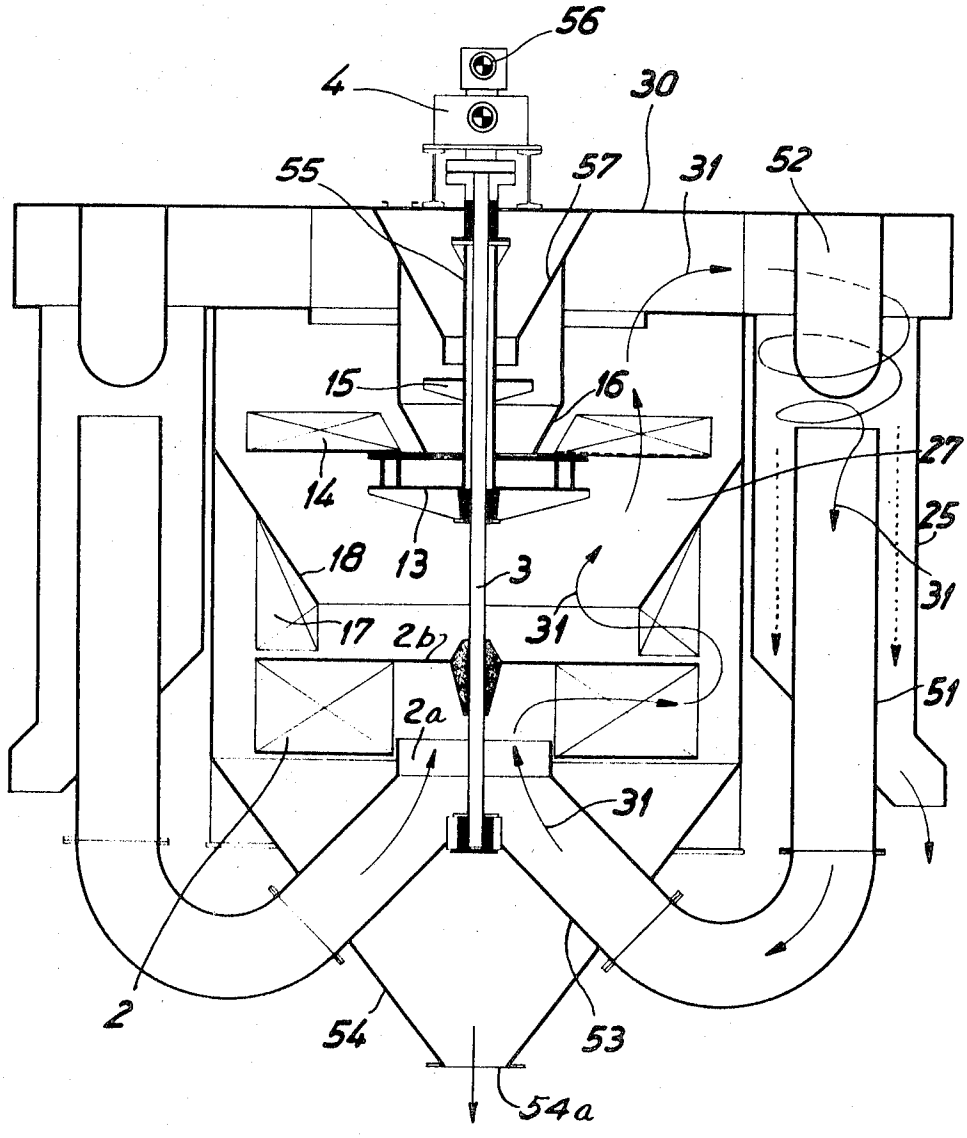

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Fig. 5

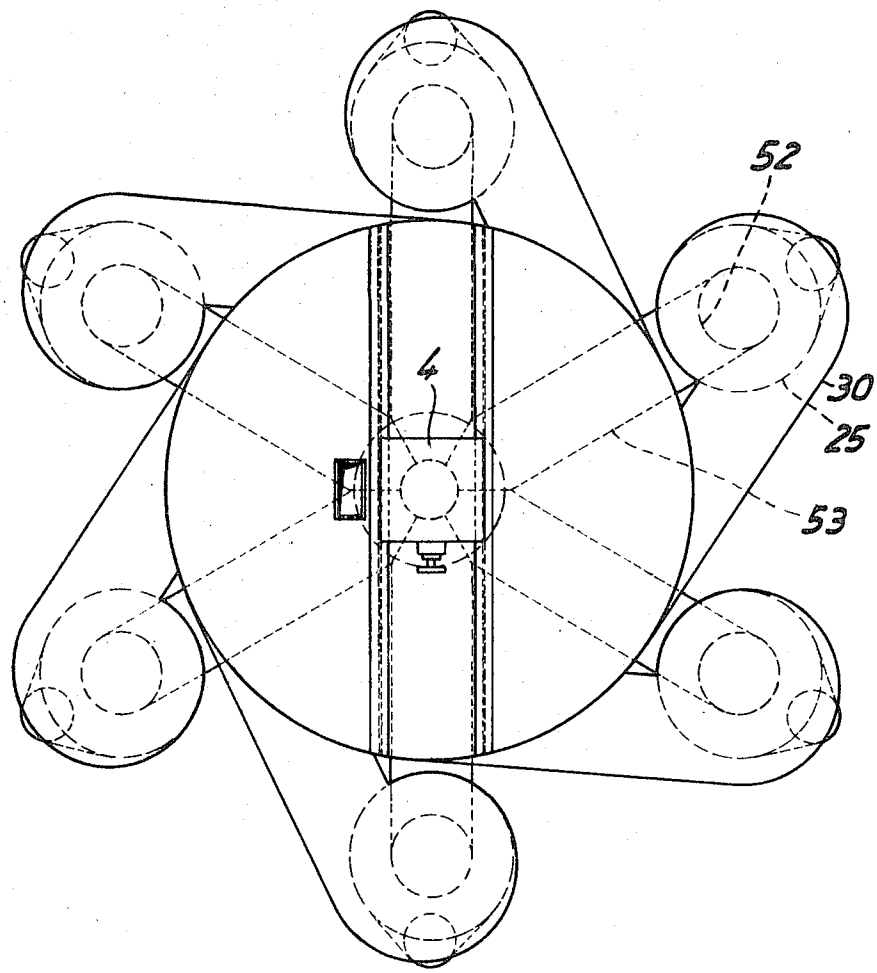


Fig.6

AIR SIFTER

BACKGROUND OF THE INVENTION

This invention relates to an air sifter with a fan disposed in the sifter housing which produces an air circulation passing through the sifter interior from below to above, having arranged in crown fashion around the sifter housing a number of dust separators to which the circulating air laden with fine material flows after passing through the sifter interior and from which the circulating air returns to the sifter interior after the fine material is separated out.

In a known air sifter of the above type the fan is disposed above the sifting space and conveys the circulating air laden with fine material into the external dust separators. After separation of the fine materials in these dust separators, the circulating air is fed back to the sifter interior through conduits connected to the bottom of the separators. In such an air sifter the fan thus has an air stream laden with fine material passing through and is, therefore, subject to appreciable wear.

To avoid this disadvantage, another known air sifter has been developed with dust separators arranged in crown fashion around the sifter housing, and with the fan outside the sifter housing, in the air stream with the fine material removed. In using such a fan, however, it has been found difficult to arrange the air suction conduits leading from individual dust separators to the fan, and the air collecting conduit leading from the fan back to the sifting area, in such a manner that the same flow conditions are provided in all dust separators. A further unfavorable point with this known air sifter is the considerable space required, due to placing the large fan outside the sifter housing.

SUMMARY OF THE INVENTION

The object of the invention is, therefore, to avoid these defects of known constructions by providing an air sifter of the type initially described, wherein the fan is disposed in a clean air stream, wherein also all dust separators have the same flow conditions, and finally wherein a particularly compact construction is achieved.

According to the invention this object is achieved in that the fan is disposed below the sifting area and is connected to the exhaust connections from the dust separators.

Placing the fan within the sifter housing leads to a very compact construction and also permits completely symmetrical passage of the tubular conduits to and from the dust separators arranged in crown fashion around the sifter housing, which ensures uniform loading of these separators and uniform air circulation in the sifting area.

The disposal of the fan below the sifting area and its connection to the exhaust connections from the dust separators ensures that the fan operates in an air stream free of solid material and is hence only subject to very slight wear.

The sifter of the invention also ensures (as will be seen from the subsequent description of some embodiments), that the material in the sifting area has circulating air passing through it three times, giving a better sifting effect than with the double passage provided in known sifters.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical section through a first embodiment of an air sifter according to the invention;

FIG. 2 is a plan view of the air sifter shown in FIG. 1;

FIG. 3 is a vertical section of a second embodiment of the invention;

FIG. 4 is a plan view of the embodiment shown in FIG. 3;

FIG. 5 is a vertical section of a third embodiment;

FIG. 6 is a plan view of the third embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The air sifter shown in FIGS. 1 and 2 contains inside the sifter housing 1 a fan 2 mounted on a central shaft 3, which is driven by means 4 disposed at the top of the sifter housing.

The shaft 3 is mounted in an upper bearing 5 and a lower bearing 6. This lower bearing 6 is held by struts 7, passing radially through the coarse material hopper 8, supported at their outer ends by springs 9 and adjustable by external means 10 so that the bearing 6 and thus the drive shaft 3 and the parts carried thereby can be aligned in an exact central position in the sifter housing 1.

Shaft 3 is firmly attached by struts 11 to a hollow shaft 12, carrying a scatter plate 13, on which is disposed a countervane system 14.

The hollow shaft 12 rotating with shaft 3 also supports a pre-distributor plate 15 surrounded at some distance by a fixed sleeve-like hood 16 inside the sifter housing 1.

Between fan 2 and scatter plate 13 is a fixed ring of shutters 17 supported by a cone 18 in the sifter housing.

Into rotating hollow shaft 12 projects a fixed tubular element 19 extending upwardly into a conical portion 20 which forms a plenum chamber at the top of the sifter housing. Passing through this conical portion 20 are two channels 21, 22, which constitute material inlets and are connected to two material inlet apertures 23, 24 and terminate above the rotating pre-distributor plate 15. The two inlet apertures 23, 24 are disposed on either side of drive means 4 for shaft 3.

Disposed in crown fashion around sifter housing 1 are a number of dust separators 25, whose air inlet pipes 26 are connected generally tangentially to the upper portion of the sifting area 27 enclosed by housing 1.

On the dip pipe 28 of each dust separator 25 is disposed a centrifugal casing 29 whose outlet air connection 30 enters the conical portion 20 substantially tangentially. The dip pipes 28 constitute the air outlets of the dust separators 25, and the outlet air connections 30, the plenum chamber formed by the conical portion 20, and the vertical suction conduit formed by the tubular element 19 and the hollow shaft 12 constitute a system of conduits which are substantially closed and which connect the air outlets of the dust separators 25 to an axial air inlet 2*a* of the fan 2, to return clean air to the fan. In the fan shown in FIG. 1, the axial inlet 2*a* is located in the upper side of the fan, while the lower side of the fan 2 is closed by a plate 2*b*, so that the air entering the fan through the inlet 2*a* is discharged radially as indicated by the arrows 31. The air which is discharged radially by the fan is directed into the coarse material flowing past the periphery of the fan toward the material outlet 8*a* at the bottom of the sifter housing, thereby stripping the last of the fine material from the falling coarse material.

The air sifter shown in FIGS. 1 and 2 operates as follows: The fan 2 produces an air stream indicated by the arrows 31. This air stream passes through sifting area 27 from below to above, is then divided between the various dust separators 25, is reunited again in conical portion 20, flows through the suction conduit formed by tubular element 19 and the hollow shaft 12, which leads the air downward to the axial air inlet of the fan, and is then reintroduced into sifting area 27 through fan 2 and the ring of shutters 17.

Material to be sifted introduced through apertures 23, 24 reaches the rotating pre-distributor plate 15 by which it is flung outwardly, then slides along the inside of hood 16, falls on the scatter plate 13 and is distributed very uniformly thereby in sifting area 27. The path of the material is indicated by arrows 32.

The coarse fraction of the material distributed in sifting area 27 falls from the sifting area and is removed through the coarse material hopper 8. The fine material, however, is entrained by the air rising spirally in sifting area 27, led to the dust separators 25 and there separated. It leaves the separators 25 through the lower exit apertures 33. In spite of its position in sifter housing 1, the fan 2 is thus operating in air containing no entrained material and suffers hardly any wear. In this connection it is desirable to protect the top of fan 2 from falling coarse material by a cover plate 34 which prevents feed particles from falling into the fan.

In the second embodiment of the invention shown in FIGS. 3 and 4 the scatter plate 13 and the pre-distributor plate 15 are rotated by drive means 35 through a first central drive shaft 36. Drive means 35 is at the bottom end of the sifter housing; the upper end of shaft 36 is mounted in a bearing 37 held by a cone 38 fixedly mounted in sifter housing 1.

The said inner drive shaft 36 is coaxially enclosed by a second drive shaft 39, formed as a hollow shaft, co-rotatably connected with fan 2 and driven by drive means 40 also disposed at the bottom of sifter housing 1.

The inlet aperture 41 for material to be sifted is at the center of the top of sifter housing 1. The material passes via two channels 21, 22 as in the first embodiment, to the pre-distributor plate 15 and from there to scatter plate 13.

In this embodiment, sifting area 27 is enclosed by an annular outer space 42 whose lower zone is linked to the outer periphery of fan 2 and whose upper zone is connected with the inlet air pipes 26 of dust separators 25.

The air conveyed from fan 2 is thus divided into two sections. The main flow passes through the ring of shutters 17 into the sifting area 27 (arrows 43), while a further section of the flow (arrow 44) flows into dust separators 25 through the annular outer space 42. At the top end of this space 42 is a throttle member 45 in the form of an adjustable ring, whereby the distribution of the air stream between sifter area 27 and the annular outer space 42 can be varied. By passing part of the air circulation by this method through annular outer space 42 in by-pass fashion, air conditions in sifter area 27 and in the dust separators 25 can be adjusted to the required optimum values independently of each other.

In the FIGS. 3 and 4 embodiment, an annular pneumatic conveyor channel 46 is provided at the base of the sifter area to extract the coarse material separated out in sifter area 27.

In contrast to the first embodiment, in the air sifter of FIGS. 3 and 4 the axes of the connecting tubular conduits 48 between the dip pipes 47 of the dust separators 25 and the conical extension 20 of the fan section air conduit are in planes which pass through the sifter axis.

Otherwise both the construction and the movements of gas and material are as in the embodiment first described.

FIGS. 5 and 6 show a further embodiment of the invention, wherein the dust separators 25 (in contrast to the previously described embodiments) have dip pipes 51 which do not lead upwardly but lead downwardly, and have displacement bodies 52 in their upper zones. The dip pipes 51 are connected to return clean air to the inlet 2*a* at the bottom of the fan 2 by means of exhaust air conduits 53 which pass through the coarse material hopper 54 of the sifter.

Fan 2 is mounted on a shaft 3 which is connected to drive means 56. The pre-distributor plate 15, scatter plate 13 and counter-vane system 14 are rotated by a hollow shaft 55 having its own drive means 4.

Material to be sifted is fed through the hopper 57 to pre-distributor plate 15 and is then spread into hood 16, then passes on to scatter plate 13, is scattered thereby into sifting area 27, moves along the wall of cone 18 on to the cover plate 2*b* which closes the upper side of fan 2 and is again carried outwards by the fan; finally the coarse material is extracted through the material outlet 54*a* of the hopper 54 at the bottom of the sifter housing.

In this way (as in the two previous embodiments) the material is altogether permeated three times by circulating air, whose path is indicated by the arrows 31. The cover plate 2*b* prevents feed particles from falling into the fan, and as indicated by the arrows 31, the fan discharges air radially into the coarse material falling past the periphery of the fan toward the material outlet 54*a*, thereby stripping the last of the fine material from the coarse material. The fine material thus entrained by the air stream is separated out in dust separators 25.

With all the embodiments a specific part of the circulating air can obviously be removed as required and replaced by hot gas or cold air.

I claim:

1. An air sifter comprising a sifter housing, a plurality of dust separators, each having an air inlet and an air outlet, arranged in crown fashion around the sifter housing, a fan which is mounted to rotate upon a vertical axis in the lower part of the sifter housing and which has an axial air inlet on one side and is closed on the other side, a system of substantially closed conduits which connects the air outlets of the dust separators to the air inlet of the fan, and which includes a plenum chamber at the top of the sifter housing, to which is connected a vertical suction conduit that is located centrally in the sifter housing and leads air downward to the axial air inlet of the fan, and through which passes at least one channel constituting a material inlet leading into the upper portion of the sifter housing, for introducing feed material to be separated, the upper side of the fan being provided with a cover plate to prevent feed particles from falling into the fan, the inlets of the dust separators being connected to the upper portion of the sifter housing to receive air, laden with fine material, which is discharged from the sifter housing under the pressure created by the fan, and a material outlet at the bottom of the sifter housing, for the discharge of coarse material which has separated from the fine material in the feed material falling from the material inlet in countercurrent to the air ascending in the air sifter housing from the fan.

2. An air sifter according to claim 2 wherein each dust separator comprises a central dip pipe which constitutes an air outlet and which is connected to the plenum chamber.

3. An air sifter comprising a sifter housing, a plurality of dust separators, each having an air inlet and an air outlet, arranged in crown fashion around the sifter housing, a fan which is mounted to rotate upon a vertical axis in the lower part of the sifter housing and which has an axial air inlet on one side and is closed on the other side, a system of substantially closed conduits connecting the air outlets of the dust separators to the air inlet of the fan, a material inlet leading into the upper portion of the sifter housing, for introducing feed material to be separated, the upper side of the fan being provided with a cover plate to prevent feed particles from falling into the fan, a pre-distributor plate and a scatter plate, both mounted to rotate upon a vertical axis above the fan in the sifter housing, a sleeve-like hood surrounding and spaced from the pre-distributor plate, the pre-distributor plate being located below the material inlet, to receive material therefrom and to distribute it against the interior of the hood, and the scatter plate being located below the hood, to receive material falling from the hood and to distribute it into the air ascending from the fan, the inlets of the dust separators being connected to the upper portion of the sifter housing to receive air, laden with fine material, which is discharged from the sifter housing under the pressure created by the fan, and a material outlet at the bottom of the sifter housing, for the discharge of coarse material which has separated from the fine material in the feed material falling from the material inlet in counter-current to the air ascending in the sifter housing from the fan.

4. An air sifter according to claim 3 wherein the fan, the scatter plate and the pre-distributor plate are mounted upon a common vertical shaft which is connected at its top to drive means and is guided below the fan by a bearing supported by adjustable radial struts.

5. An air sifter according to claim 3 wherein the scatter plate and pre-distributor plate are mounted upon a first central drive shaft and the fan is mounted upon a second drive shaft coaxially surrounding the first drive shaft, the shafts are connected at their lower ends to separate drive means, and an annular pneumatic conveyor channel is disposed at the base of the sifter housing for extracting the coarse material.

6. An air sifter comprising a sifter housing, a plurality of dust separators, each having an air inlet and an air outlet, arranged in crown fashion around the sifter housing, a fan which is mounted to rotate upon a vertical axis in the lower part of the sifter housing and which has an axial air inlet on one side and is closed on the other side, a system of substantially closed conduits connecting the air outlets of the dust separators to

the air inlet of the fan, a material inlet leading into the upper portion of the sifter housing, for introducing feed material to be separated, the upper side of the fan being provided with a cover plate to prevent feed particles from falling into the fan, an annular baffle disposed above the fan comprising a ring of shutters through which the air is directed spirally inward and is thus set in rotary motion, the inlets of the dust separators being connected to the upper portion of the sifter housing to receive air, laden with fine material, which is discharged from the sifter housing under the pressure created by the fan, and a material outlet at the bottom of the sifter housing, for the discharge of coarse mateiral which has separated from the fine material in the feed material falling from the material inlet in countercurrent to the air ascending in the sifter housing from the fan.

7. An air sifter according to claim 6 wherein the annular baffle is arranged to guide falling coarse material inside the baffle onto the top of the fan to be scattered centrifugally thereby.

8. An air sifter according to claim 7 wherein the fan has a cover plate to receive and scatter the falling coarse material.

9. An air sifter comprising a sifter housing, a plurality of dust separators, arranged in crown fashion around the sifter housing, each having an air inlet connected to the upper portion of the sifter housing and an air outlet, and a material inlet leading into the upper portion of the sifter housing, for introducing feed material to be separated, wherein the improvement comprises a material outlet at the bottom of the sifter housing, for the discharge of coarse material, a fan which is located above the material outlet, is mounted to rotate upon a vertical axis in the lower part of the sifter housing, has an axial air inlet on one side and is closed on the other side, the upper side of the fan being provided with a cover plate to prevent feed particles from falling into the fan, and the fan discharging air radially into the coarse material falling past the fan toward the material outlet, thereby stripping the last of the fine material from the coarse material, and a system of substantially closed conduits connecting the air outlets of the dust separators to the air inlet of the fan to return clean air to the fan.

10. An air sifter according to claim 9 wherein each dust separator inlet is in the form of a pipe extending generally tangentially from the upper portion of the sifter housing.

11. An air sifter according to claim 7, wherein each of the dust separators comprises a central dip pipe which constitutes an air outlet, and which is connected to a system of conduits leading to the axial air inlet of the fan.

12. An air sifter according to claim 8 wherein the system of conduits connecting the air outlets of the dust separators to the air inlet of the fan includes a hollow vertical shaft which rotates with the fan.

13. An air sifter according to claim 9 wherein an annular passage is provided immediately inside the sifter housing, leading from the outer periphery of the fan to the inlets of the dust separators.

14. An air sifter according to claim 13 wherein the annular passage is provided with an adjustable throttle member for regulating the proportion of the air flow that is bypassed through the annular passage.

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