

[54] **PNEUMATIC REFUSE MATERIAL SEPARATION SYSTEM**

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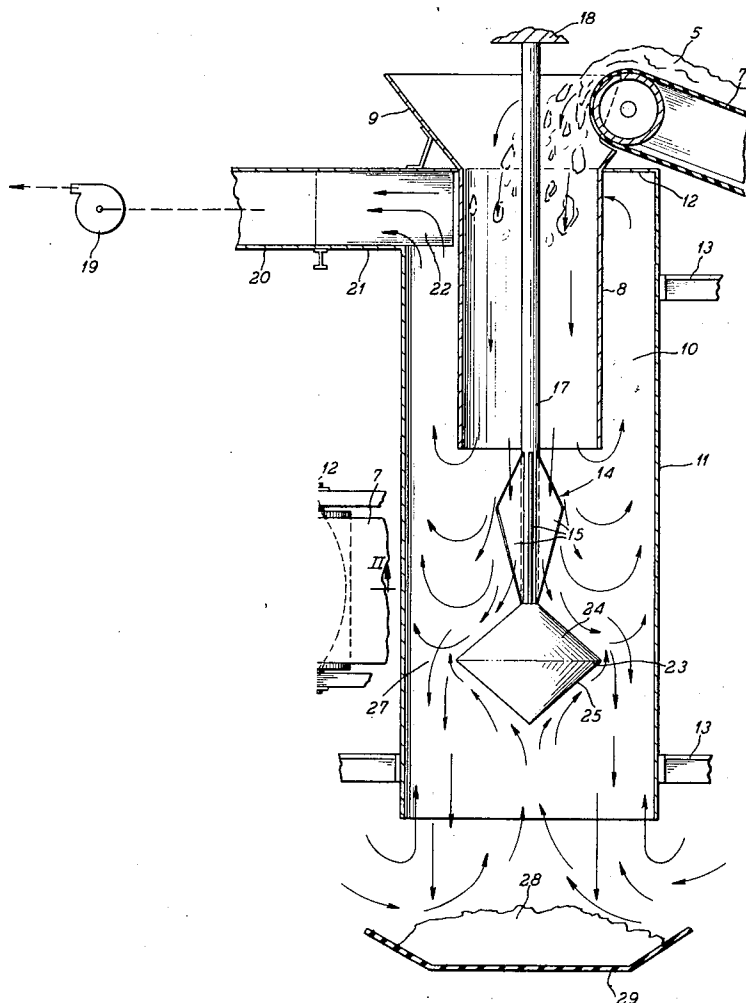
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[57] **ABSTRACT**

Light and heavy constituents of refuse material are separated by delivering the material through a tubular inlet into the upper portion of a vertical separating chamber to drop onto and past declumping means and then to a spreader which directs it to fall through an annular venturi throat. As the material descends it is subjected to upwardly moving air of substantial velocity to separate lighter constituents of the material and draw them off from the separating chamber above the discharge end of the inlet. Heavier constituents are collected from the lower portion of the chamber spaced below the spreader.

16 Claims, 2 Drawing Figures



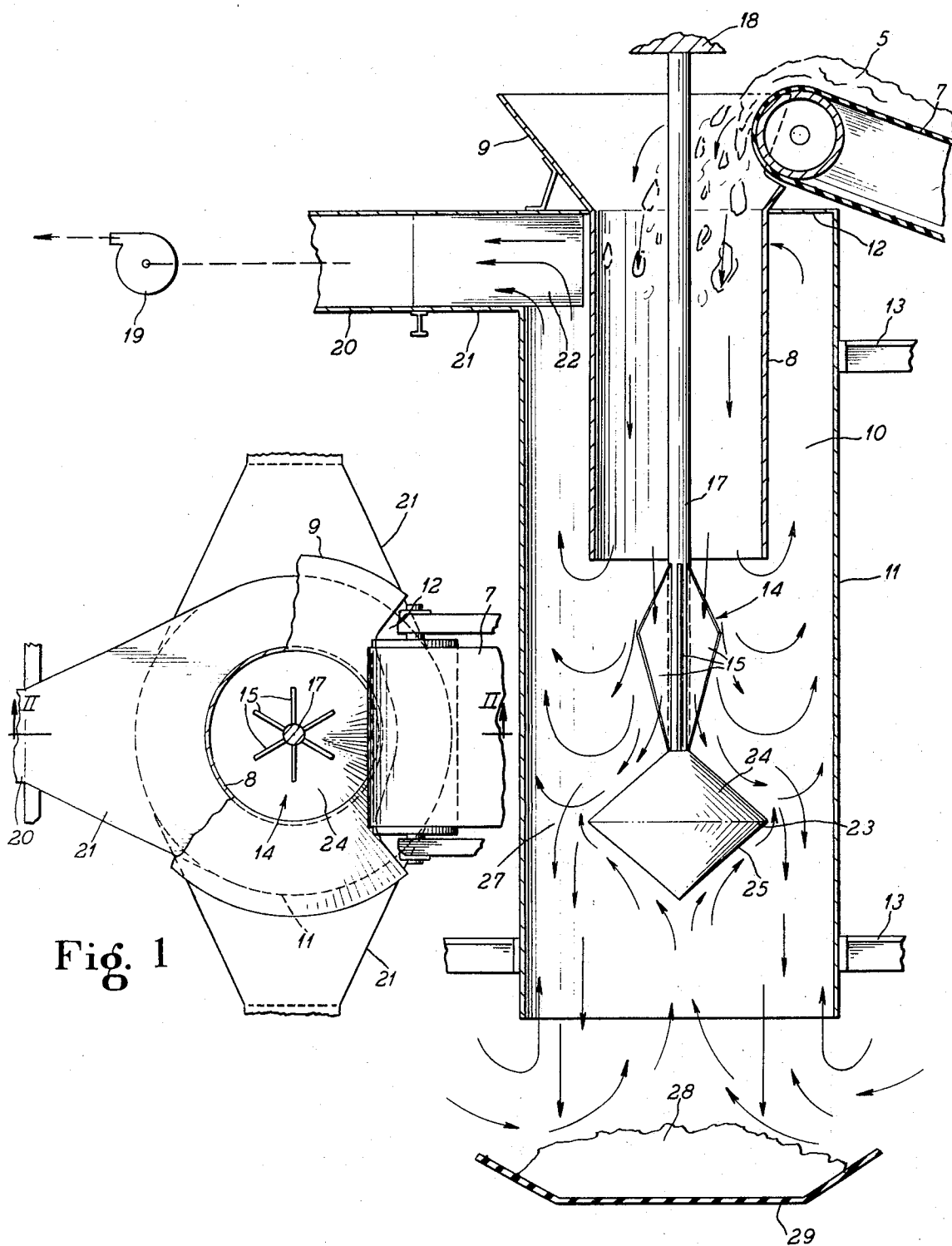


Fig. 2

PNEUMATIC REFUSE MATERIAL SEPARATION SYSTEM

This invention relates to materials separation, and is more particularly concerned with a pneumatic refuse material separation system. Refuse materials such as municipal garbage and trash, now generally collected without discrimination, present substantial problems in separation thereof for recovery of reusable raw products such as paper, glass and metals. It is to the solving of these problems that the present invention is directed.

An important object of the invention is to provide a new and improved pneumatic refuse material separation system.

Another object of the invention is to provide a new and improved means for efficiently separating diverse materials such as municipal or other refuse for recovering reusable constituents.

A further object of the invention is to provide a new and improved pneumatic material separating system.

Other objects, features and advantages of the invention will be readily apparent from the following description of certain preferred embodiments thereof, taken in conjunction with the accompanying drawing although variations and modifications may be effected without departing from the spirit and scope of the novel concepts embodied in the disclosure, and in which:

FIG. 1 is a fragmentary top plan view of a system embodying features of the invention;

FIG. 2 is a vertical sectional detail view taken substantially along the line II—II of FIG. 1.

Loose refuse material 5 such as municipal trash and garbage is delivered as by means of an endless conveyor 7 into the upper end of a tubular inlet 8 which is desirably provided with an upwardly flaring funnel-like mouth head structure 9. Within the inlet 8 the material is guided to drop down into a downwardly opening separating chamber 10 defined by means comprising a columnar casing providing wall 11 of substantial length about the chamber, with the inlet 8 of smaller diameter and extending concentrically downwardly to a limited extent through and below a top closure 12 into the separating chamber. Suitable frame structure 13 supports the vertical chamber wall 11 and the inlet 8 carried by the chamber wall through the top closure 12.

For breaking up descending clumped masses of the material to be separated, declumping means 14 are provided adjacently below the discharge end of the inlet 8. In a desirable construction, the declumping means 14 comprise a set of radial vanes 15 disposed in vertical planes and of preferably triangular shape in elevation. Support for the vanes 15 is provided by means such as a vertical bar or rod 17 which extends vertically concentrically through the inlet 8 and is suspended, preferably rigidly, from supporting means 18 such as a ceiling or other supporting structure above the receiving head 9 of the inlet. In diameter, the suspension rod 17 is as small as practicable for the purpose and throughout its length within the inlet the rod is smooth and free from obstructions on which material might catch, so that the passage through the inlet is practically free for dropping of material to be separated downwardly therethrough into the chamber 10 toward the declumper 14. Each of the vanes 15 is fixedly secured to the supporting rod 17 at an elongated hypotenuse and with the vanes radiating in uniformly spaced

relation to a common diameter at their convergent edge peaks approximately one-half that of the inlet diameter. In a desirable arrangement there are six of the vanes 15, as shown. Through this arrangement, the vanes 15 efficiently break-up larger masses or clumps of adherent material, but avoid catching of the material thereon.

Within the chamber 10 the descending material is subjected to pneumatic separation by forcing air upwardly through the material for thereby carrying off the lighter constituents of the material, such as paper. Preferably the separating air-flow is effected by means causing a suction primarily upwardly through the chamber 10 from the lower open end of the wall casing 11. For this purpose, a suitable blower 19 is connected with an exhaust duct 20 leading from an exhaust throat 21 communicating by way of a wide angle exit opening 22 with the upper end of the chamber 10 immediately below the top closure 12 and at a substantial height above the lower end of the inlet 8. Although at least one exhaust opening and duct may be provided, a plurality of such exhaust arrangements may be provided at circumferentially spaced intervals (FIG. 1) at the same or graduated elevations and providing for the same suction velocity or graduated suction velocities, as may be preferred.

To enhance separating effect of the pneumatic column in the separating chamber 10, velocity increasing means are provided, comprising a spreader and venturi member 23. For this purpose, the spreader 23 is supported in fixed suspended relation from the lower end of the rod 17 preferably coincident with the lower end of the declumper 14. On its upper end the spreader 23 has a generally downwardly and radially tapering spreader surface 24 which joins a reversely tapering conical air deflecting undersurface 25, with the surfaces meeting at a perimeter of a diameter about the same as the diameter of the inlet 8. Between the perimeter of the spreader 23 and the surrounding portion of the chamber wall 11 is defined an annular venturi velocity increasing throat 27. Thereby descending material deflected into the venturi throat is subjected to high velocity separating air with an advantageous pressure drop above the throat for large volume air lifting and tumbling of the descending materials for separation of the lighter constituents which are then sucked up the reduced cross-section chimney area between the inlet 8 and the wall 11. Downward movement of the material to be separated, and countermovement of the air and lifting of the lighter materials is graphically shown by means of directional arrows. This air separation is enhanced by the flow path along the unobstructed passage provided within the wall casing 11 which provides a flow unobstructed except for the spreader 23, entirely down to the lower end outlet opening from the casing.

Constituents of the materials to be separated, which are heavier than will be lifted by the ascending air, drop down below the spreader 23 and discharge from the separating chamber through preferably open lower end provided by the wall casing 11 and are collected as shown at 28 on means such as a conveyor 29 for further separating action or for disposal.

Although only one of the separators according to the present invention has been disclosed, it will be understood that there may be as many of such separators as necessary to handle any given volume of refuse, and

there may be batteries of the separators in series for multiple raw product separation. In such an installation raw products such as paper, glass and metals are segregated and collected, land fill refuse is packed into transporting and dumping apparatus, and such refuse or trash as cannot be reused or recycled may be burned in an incinerator which provides heat for drying valuable raw products such as paper.

It will be understood that variations and modifications may be effected without departing from the spirit and scope of the novel concepts of this invention.

We claim as our invention:

1. In a pneumatic refuse material separation system:

means defining a wall about a vertical separation chamber;

a tubular inlet through which material to be separated is received and which is of smaller diameter than the chamber and extends to a limited extent downwardly within the upper portion of the chamber, with a discharge end of the inlet opening freely downwardly within the chamber;

means for supplying material to be separated into said inlet to drop therefrom through said discharge end downwardly into the chamber;

declumping means comprising a plurality of circumferentially spaced edges adjacently below said discharge end and in the path of discharging material for breaking up descending adherent masses of material;

spreader means for receiving and spreading the descending material laterally below the declumping means and above the lower end of the chamber and defining an annular venturi throat with said wall;

means for effecting separating air-flow upwardly through said chamber and the venturi throat and past said declumping means and said inlet to separate lighter constituents from said material; and

means for receiving heavier constituents from the lower portion of the chamber spaced below said spreader means.

2. A system according to claim 1, including a supporting rod extending down through said inlet and supporting said declumping means longitudinally therealong.

3. A system according to claim 2, wherein said declumping means comprise a set of radially extending circumferentially spaced generally triangular vanes carried by said rod and providing said edges.

4. A system according to claim 3, wherein said spreader comprises a member supported by said rod at the lower end of said set of declumping vanes.

5. A system according to claim 1, wherein said declumping means comprises a set of radially extending circumferentially spaced vanes extending to a diameter about one-half that of the diameter of said inlet, said spreader means comprises a member which is about the same diameter as said inlet, and means supporting said declumping means and said spreader means concentrically relative to said inlet and to said chamber.

6. A system according to claim 1, wherein said wall-defining means comprise a vertical casing having a top closure through which said inlet extends concentrically with respect to said chamber, said means for separating air flow including an exhaust outlet in said casing adjacent to said closure and leading off laterally from the casing in the form of a throat extending from a wide

angle exit opening in the upper end of the casing, the throat having side walls which extend tangentially from the casing and converge toward an exhaust duct.

7. In a pneumatic refuse material separation system:

delivering material to be separated to the upper end of a tubular inlet which projects down to a limited extent into the upper portion of a separating chamber;

dropping the material from the lower end of said inlet onto a plurality of circumferentially spaced edges of and past a declumper located a substantial distance below said inlet and thereby breaking up descending adherent masses of material;

dropping the material beyond the declumper onto a spreader and thereby directing the descending material into a venturi throat defined between the spreader and a casing wall about the separating chamber;

forcing separating air at substantial velocity upwardly through the chamber including said venturi throat and through the descending material and lifting separated lighter constituents of the material upwardly past the declumper and inlet and out of an exhaust opening in the upper portion of the chamber;

and collecting heavier constituents of the material from the lower portion of the chamber below the spreader.

8. A system according to claim 7, including subjecting the descending material to substantial pressure drop in a space between the spreader and the inlet and in the vicinity of the declumper.

9. In a pneumatic refuse material separation system: means defining a wall about a cylindrical vertical separation chamber;

a tubular inlet through which material to be separated is received and which is of smaller diameter than the chamber and extends to a limited extent downwardly within the upper portion of the chamber, with a discharge end of the inlet opening freely downwardly within the chamber;

means for supplying material to be separated into said inlet to drop therefrom through said discharge end downwardly into the chamber;

a supporting rod suspended at its upper end above the point at which material is introduced into said inlet and extending concentrically downwardly through the inlet with the lower end of the rod extending substantially below the lower end of the inlet;

a spreader member suspended from the lower end of said rod a substantial distance below and concentric with the lower end of said inlet and above the lower end of said chamber and being of substantially the same diameter as said inlet and of smaller diameter than said chamber wall and having convergently related conical upper and lower surfaces, the upper surface providing a spreader surface and the lower surface providing an air deflecting surface;

said surfaces meeting in annularly spaced relation to said chamber wall and defining an annular venturi throat with said wall;

said separation chamber wall providing an air-flow passage which is unobstructed except for said spreader and is unstricted entirely down to the

lower end of the chamber which has a free outlet opening downwardly therefrom;

means for effecting material separating air flow upwardly through said chamber, through the venturi throat and past said spreader and then past said inlet, to separate lighter constituents from said material; and

means for receiving heavier constituents which drop from said outlet.

10. A system according to claim 9, wherein said wall-defining means comprise a vertical casing having a top closure through which said inlet extends concentrically with respect to said chamber, said means for separating air flow including an exhaust outlet in said casing adjacent to said closure and leading off laterally from the casing in the form of a throat extending from a wide angle exit opening in the upper end of the casing, the throat having opposite side walls which extend generally tangentially from opposite sides of the casing and converge toward an exhaust duct.

11. In a pneumatic refuse material separation system:

means defining a wall about a vertical separation chamber;

a tubular inlet through which material to be separated is received and which is of smaller diameter than the chamber and extends to a limited extent downwardly within the upper portion of the chamber, with a discharge end of the inlet opening freely downwardly within the chamber;

means for supplying material to be separated into said inlet to drop therefrom through said discharge end downwardly into the chamber;

a supporting rod suspended at its upper end above the point at which material is introduced into said inlet and with the lower end of the rod extending substantially below the discharge end of the inlet;

a spreader member suspended from the lower end of said rod below the discharge end of said inlet and above the lower end of said chamber and being of as large diameter as said inlet but of smaller diameter than said chamber wall and having convergently related conical upper and lower surfaces, the upper surface providing a spreader surface and the lower surface providing an air deflecting surface;

said surface meeting in annularly spaced relation to said chamber wall and defining an annular venturi throat with said wall;

means for effecting material separating air flow upwardly through said chamber and the venturi throat and past said spreader and said inlet to separate lighter constituents from said material;

means for receiving heavier constituents from the lower portion of said chamber spaced below said spreader; and

decumpling means comprising a plurality of circumferentially spaced edges carried by said rod adjacently below said discharge end of said inlet and above said spreader for breaking up adherent masses of material descending from said discharge end.

12. A system according to claim 11, wherein said edges are provided by a set of radially extending circumferentially spaced vanes projecting to a diameter about one half that of the diameter of said inlet, and said spreader at the meeting of said surfaces at the ven-

turi throat being of a diameter about the same as the diameter of said inlet.

13. In a pneumatic refuse material separation system:

means defining a wall about a vertical separation chamber;

a tubular inlet through which material to be separated is received and which is of smaller diameter than the chamber and extends to a limited extent downwardly within the upper portion of the chamber, with a discharge end of the inlet opening freely downwardly within the chamber;

means for supplying material to be separated into said inlet to drop therefrom through said discharge end downwardly into the chamber;

spreader means for receiving and spreading the descending material laterally below said discharge end and above the lower end of the chamber and defining an annular venturi throat with said wall;

means for effecting separating air-flow upwardly through said chamber and the venturi throat and past said inlet to separate lighter constituents from said material;

said separation chamber wall providing an air-flow passage which is unobstructed except for said spreader and is unstricted entirely down to the lower end of the chamber which has a free outlet opening therefrom;

means spaced below said outlet for receiving heavier constituents which drop through the upwardly flowing air past said spreader; and

decumpling means comprising a plurality of circumferentially spaced edges located adjacently below said discharge end of said inlet and above said spreader for breaking up adherent masses of material descending from said discharge end.

14. A system according to claim 13, wherein said edges are provided by a set of radially extending circumferentially spaced vanes projecting to a diameter about one half that of the diameter of said inlet, and said spreader at the meeting of said surfaces at the venturi throat being of a diameter about the same as the diameter of said inlet.

15. In a pneumatic refuse material separating system:

means defining a wall about a vertical separation chamber;

a tubular inlet through which material to be separated is received and which is of smaller diameter than the chamber and extends to a limited extent downwardly within the upper portion of the chamber, with a discharge end of the inlet opening freely downwardly within the chamber;

means for supplying material to be separated into said inlet to drop therefrom through said discharge end downwardly into the chamber;

spreader means for receiving and spreading the descending material laterally below said discharge end and above the lower end of the chamber and defining an annular venturi throat with said wall;

means for effecting separating air-flow upwardly through said chamber and the venturi throat and past said inlet to separate lighter constituents from said material;

said separation chamber wall providing an air-flow passage which is unobstructed except for said spreader and is unstricted entirely down to the

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lower end of the chamber which has a free outlet opening therefrom;
means spaced below said outlet for receiving heavier constituents which drop through the upwardly flowing air past said spreader;
said wall-defining means comprising a vertical casing having a top closure through which said inlet extends concentrically with respect to said chamber;
said means for separating air-flow including an exhaust outlet in said casing adjacent to said closure and leading off laterally from the casing in the form of a throat extending from a wide angle exit opening in the upper end of the casing; and

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said throat having opposite side walls which extend from the full width of said opening and generally tangentially from opposite sides of the casing and converge toward an exhaust duct.

5 16. A system according to claim 15, including at least one more exhaust outlet in said casing adjacent to said closure and to said first mentioned exhaust outlet and leading off laterally from the casing in the form of a throat extending from a wide angle exit opening in the upper end of the casing and having opposite side walls which extend generally tangentially from opposite sides of the casing and converge toward an exhaust duct.

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