

[54] AIR CLASSIFIER FOR SHREDDED REFUSE

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[58] Field of Search 209/136-139 R, 209/140-142, 147, 145, 36, 37; 55/402, 401, 461

[56]

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Primary Examiner—Frank W. Lutter

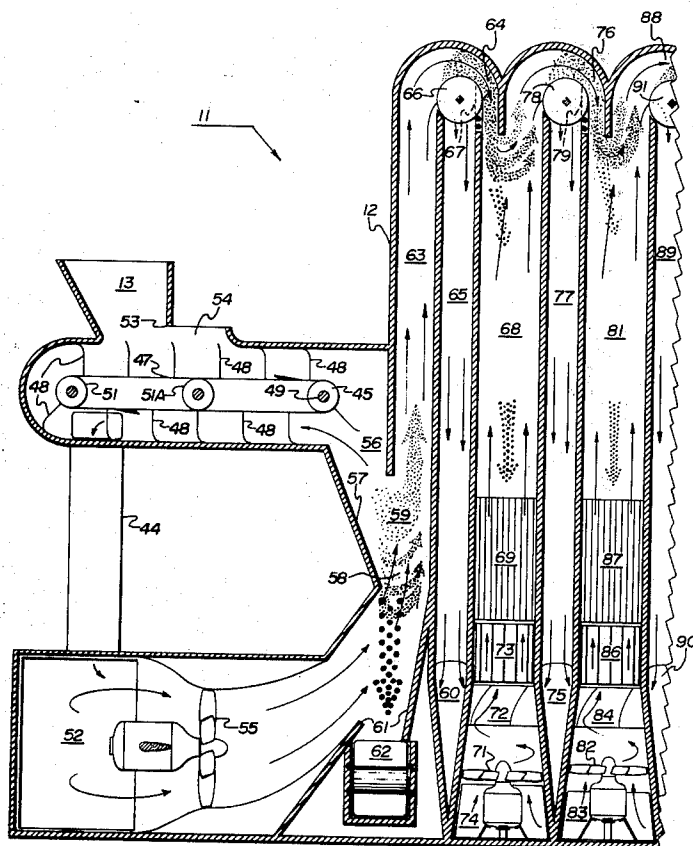
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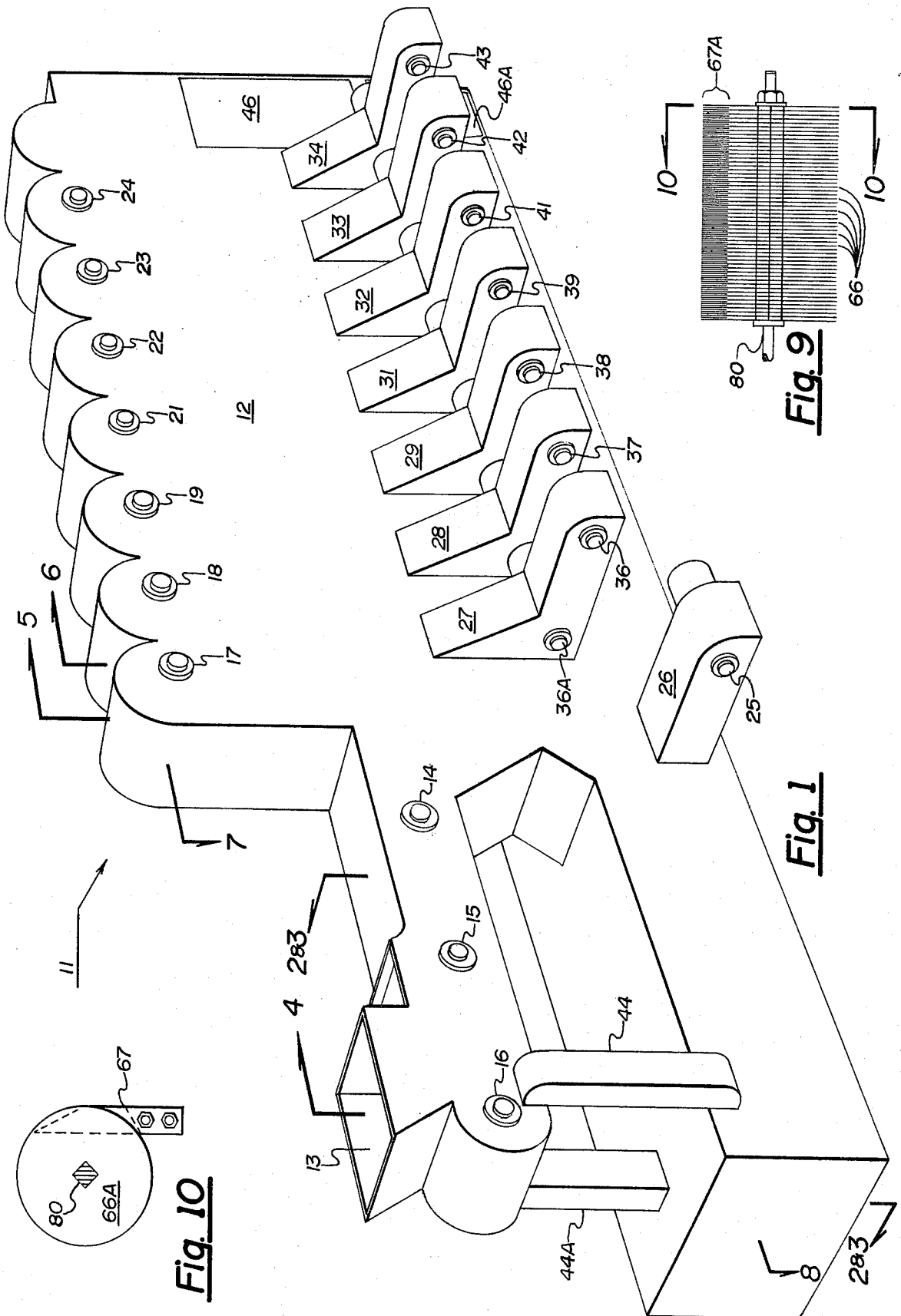
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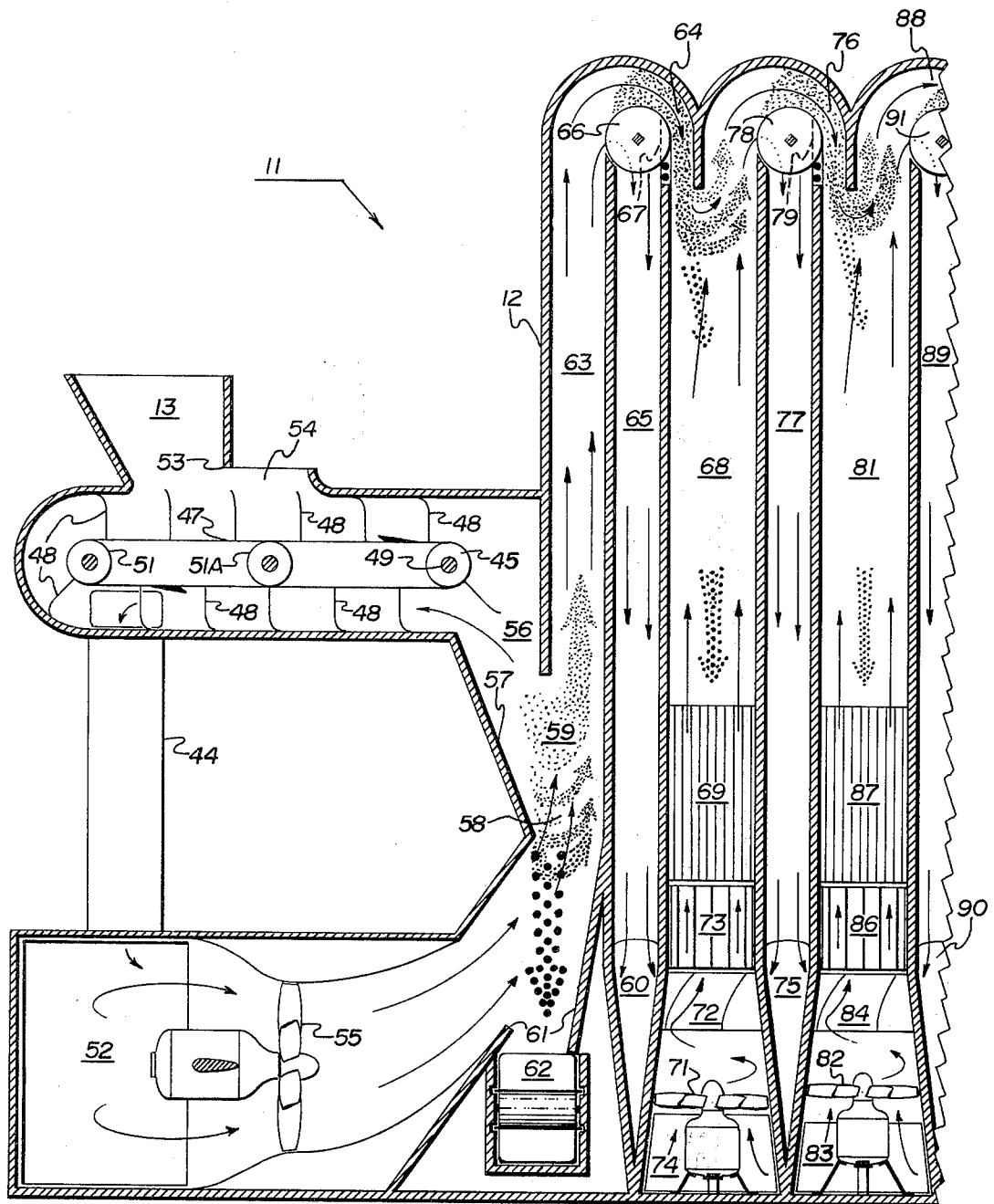
ABSTRACT

An air classifier for shredded refuse in which the shredded material to be sorted on a weight versus surface area basis is placed into an initial input chute which raises the shredded material through an upwardly moving column of air into a compression throat where the majority of rising air is passed through a series of vanes to a return manifold input. The acceptable refuse from compression throat is carried into a first sorting column where a rising air mass of slightly lower velocity than that of conduit air mass performs the first fine sorting, i.e., the heavier material and the material of low surface area drops and is deflected out of the air stream into a suitable container. The remainder of the material then rises with the air stream through a second compression throat and into a second sorting column where a rising air mass of still lower velocity is present. This is repeated until the required number of classifications have taken place and the air is finally filtered and returned to the return manifold where it repeats its passage upward through the sorting columns.

6 Claims, 10 Drawing Figures





Fig. 2

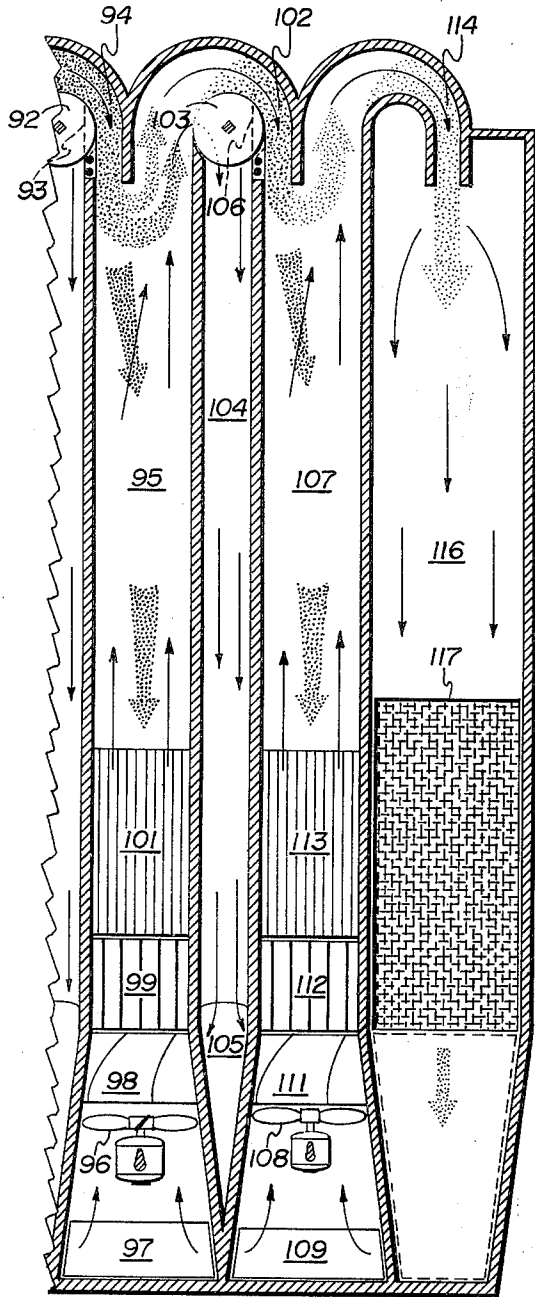


Fig. 3

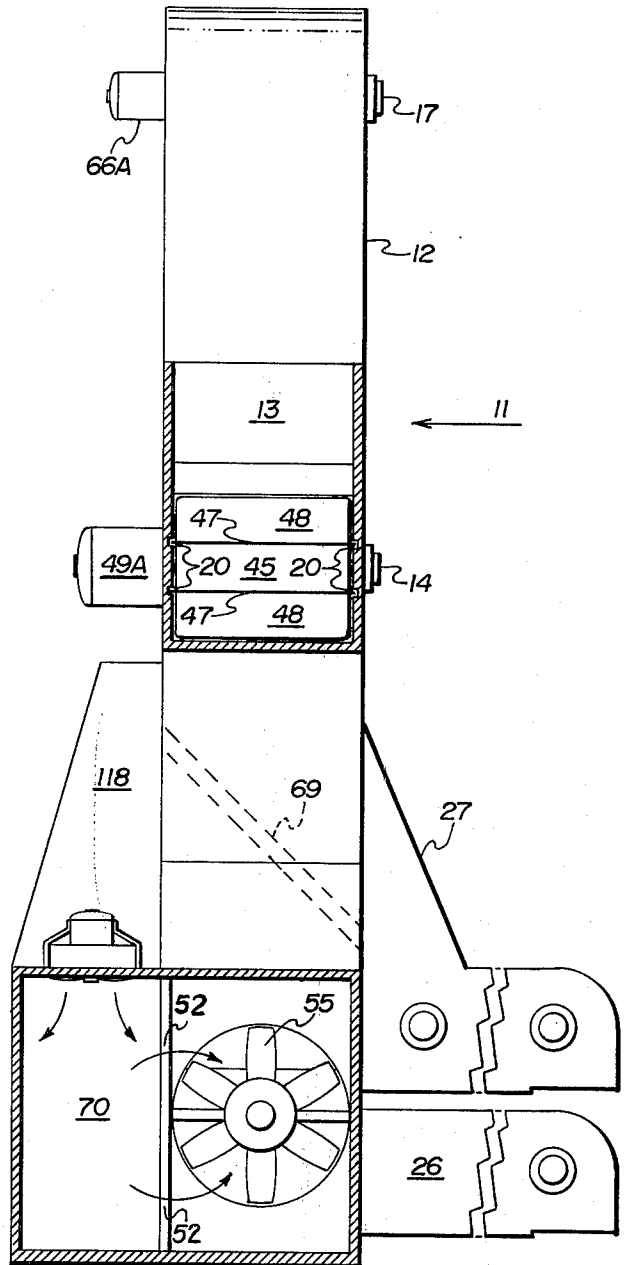


Fig. 4

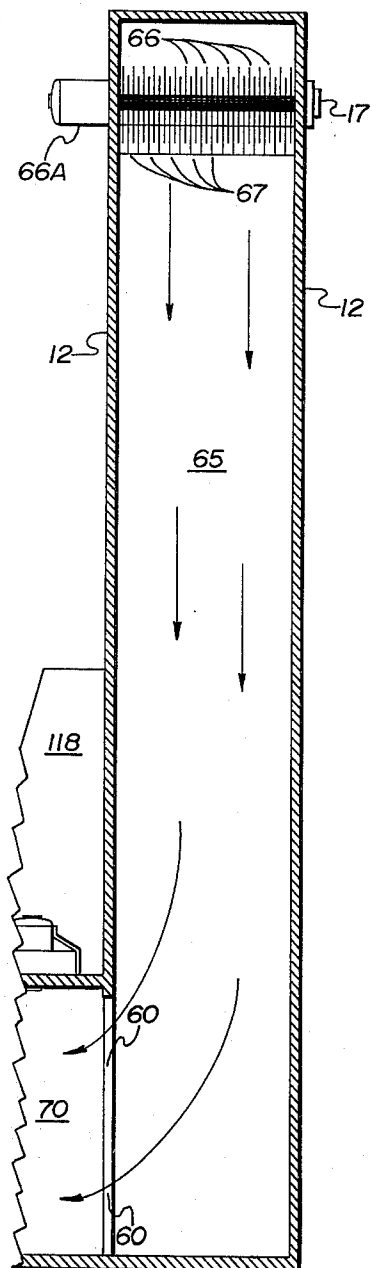


Fig. 5

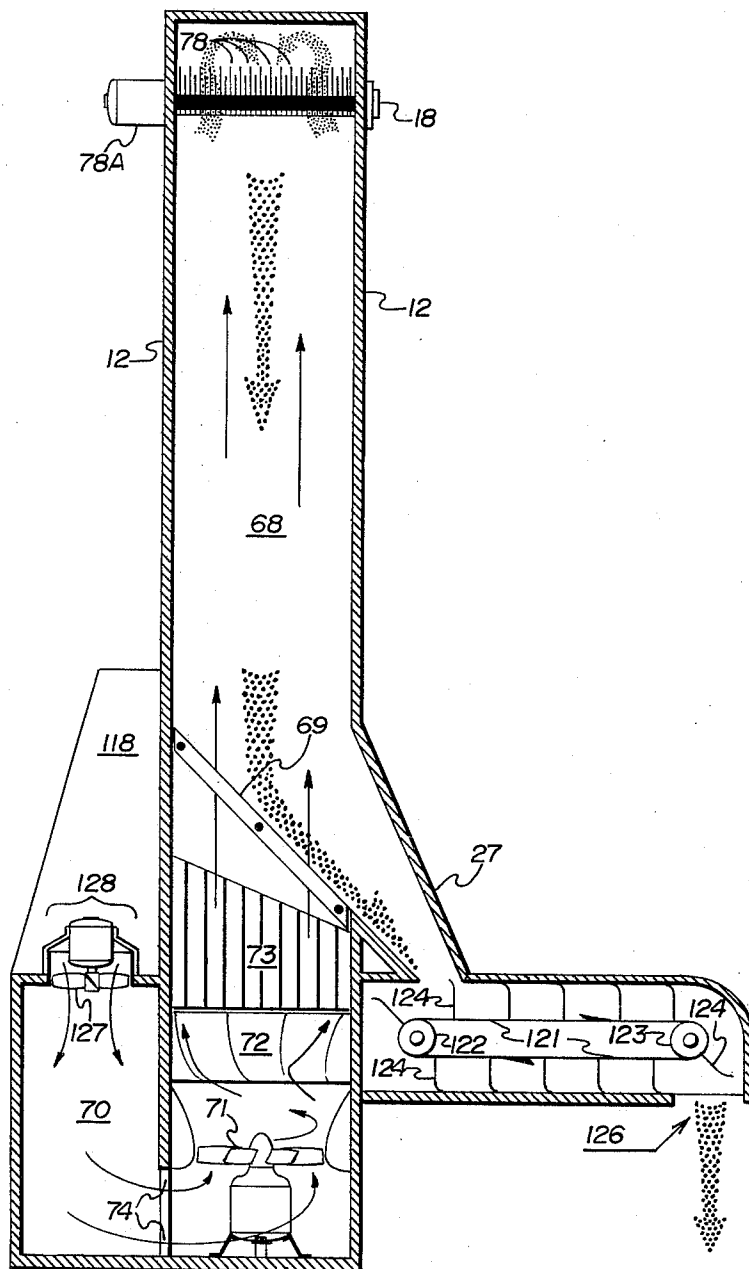
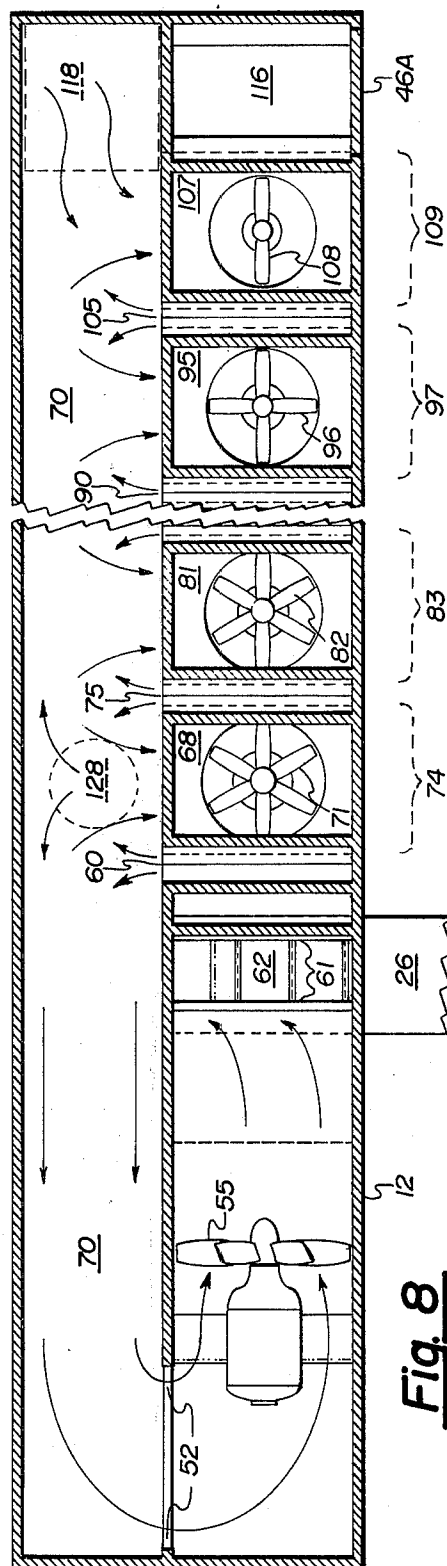
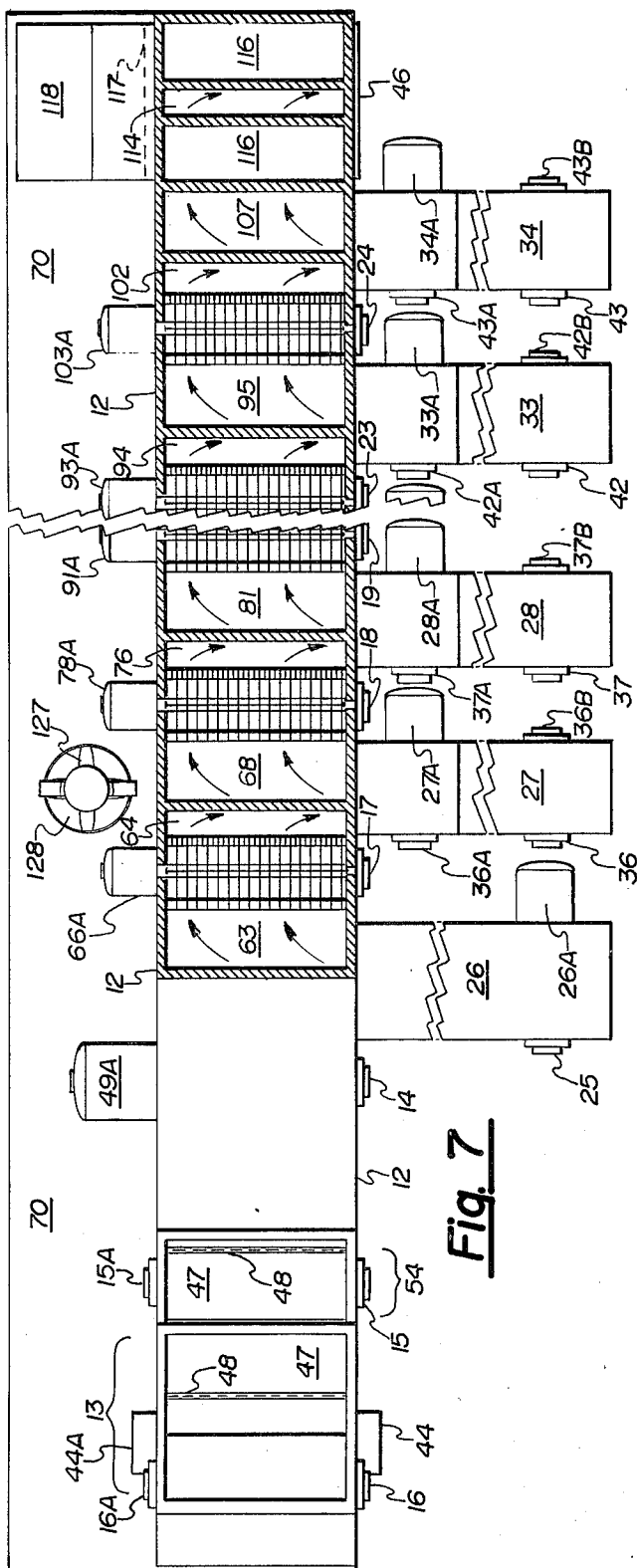


Fig. 6



AIR CLASSIFIER FOR SHREDDED REFUSE**BRIEF DESCRIPTION OF THE INVENTION**

The present invention relates to an air classifier for material and more particularly to an air classifier for material in which the air is recycled.

According to the invention, an air classifier for material such as shredded refuse is provided in which an input hopper receives unclassified shredded refuse which is carried through a sealable conveyor into a gross separation conduit where the majority of material is carried upward by a vertical column of moving air into a compression throat at the top of the column. While the remainder of the description is in reference to shredded refuse, it is to be understood that any air classifiable material can be utilized. The heavier refuse which does not fit into the classification categories of the classifier falls into the bottom of the conduit and is removed much the same as the incoming refuse is carried into the conduit, both of which have suitable air sealing means. The remaining shredded refuse then passes through the compression throat portion and into the first sorting column which again has upwardly moving air at a slightly lower velocity than that in the sorting column. In the compression throat between the sorting conduit and the sorting column a group of rotating air return vanes allow the majority of the vertically rising air in the sorting conduit to enter a return manifold and keep the shredded refuse moving into the first sorting column. The first sorting column has a vertically rising air mass which carries a portion of the shredded refuse into a second compression throat and allows the heavier and coarser shredded refuse to fall through a deflecting grate where the first settling refuse fraction is deflected out of the air stream and carried into a suitable container. The same action takes place in any desired number of sorting columns with the vertically rising air at a lower velocity in each succeeding column for lifting succeeding lighter portions of the shredded refuse. After the last sorting column the air is filtered and returned to the return air manifold. The return manifold is, of course, in communication with the air input of all of the sorting columns, each of which is supplied by a fan and a suitable air columnater, for supplying the vertically rising air. Hence, an air classifier for shredded refuse is provided which is a substantially closed system, i.e., the air carrying the refuse is only exhausted in minute, low-velocity amounts at various disposal housings associated with the various sequential sorting columns, which results in an extremely clean classification system. Periodically, of course, the filter must be replaced or cleaned as required.

An object of the present invention is the provision of an improved air classifier for shredded refuse.

Another object is the provision of an air classifier for shredded refuse which is an essentially closed and sealed air system.

A further object of the invention is the provision of an air classifier for shredded refuse in which any number of individual classifications can be accommodated.

Yet another object of the invention is the provision of an air classifier for shredded refuse which is inexpensive and simple to manufacture and operate.

Other objects and many of the attendant advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in

connection with the accompanying drawings in which like reference numerals designate like parts throughout the Figures thereof and wherein:

FIG. 1 is a perspective view of the preferred embodiment of the present invention;

FIG. 2 is a sectional view taken along lines 2 — 2 of FIG. 1;

FIG. 3 is a sectional view taken along lines 3 — 3 of FIG. 1;

FIG. 4 is a sectional view taken along line 4 of FIG. 1;

FIG. 5 is a sectional view taken along line 5 of FIG. 1;

FIG. 6 is a sectional view taken along line 6 of FIG. 1;

FIG. 7 is a sectional view taken along line 7 of FIG. 1;

FIG. 8 is a sectional view taken along line 8 of FIG. 1;

FIG. 9 is a downward looking plan view of the air return vanes of FIG. 2; and

FIG. 10 is an end elevational view of the air return vanes taken along lines 10 — 10 of FIG. 9.

DETAILED DESCRIPTION OF THE DRAWING

Referring to FIG. 1, the air classifier for shredded refuse is shown generally at 11 having a housing 12 which has an inlet hopper 13 beneath which is a conveyor belt (not shown) partially supported through bearing plates 14, 15 and 16. Bearing plates 17, 18, 19, 21, 22, 23 and 24 support axles which in turn carry rotating air return vanes (not shown). Housing 12 carries disposal housings 26, 27, 28, 29, 31, 32, 33 and 34 which have openings at their bottom portion. Disposal housing 26 carries bearing plate 25 which carries a conveyor belt (not shown). Housing 27 carries bearing plates 36 and 36A which support a conveyor belt (not shown); housing 28 carries bearing plate 37, housing 29 carries bearing plate 38, housing 31 carries bearing plate 39, housing 32 carries bearing plate 41, housing 33 carries bearing plate 42, and housing 34 carries bearing plate 43. All of these bearing plates support conveyor belts for conveying shredded refuse away from housing 12. Hollow conveyor pedestals 44 and 44A communicate with an air return section directly beneath hopper 13. Residue removal hatches 46 and 46A give access to an air filter (not shown) and the area below it.

Referring to FIG. 2, the air classifier for shredded refuse is again shown in partial lengths at 11 having a housing 12. Hopper 13 communicates with a conveyor belt 47 which has a plurality of sealing vanes 48 which are in frictional and slidable engagement with the inner walls of housing 12. Conveyor belt 47 is driven by a roller 45 on an axle 49 and is carried at another end and at the center by idlers 51 and 51A, respectively. The conveyor pedestal and air returns 44 and 44A (not shown) communicate with the bottom portion of the conveyor belt 47 area and with air return port 52. Air return port 52 serves as a port between air return manifold 70 (not shown) and a main air fan 55.

A guillotine plate 53 is on one side of input hopper 13 and an inspection port 54 is adjacent thereto. Initial input chute 56 is partially defined by a sheeting slope 57 which communicates with high velocity throat 58 which in turn communicates with gross separation area 59. Overweight hopper 61 communicates with sealed overweight conveyer 62. Gross sort residue conduit 63

communicates with compression throat 64 which in turn communicates with air return column 65 and return port 60 through velocity matched air return vanes 66. Vane combs 67 are interspersed with air return vanes 66.

Compression throat 64 communicates with first sorting column 68 containing a first fraction deflecting grate 69. Fan 71 communicates with vortex eliminator vanes 72 which communicate with laminar flow vanes 73 and first sorting column 68. The air source for fan 71 is a first column output port 74. First sorting column 68 terminates in its upward portion in a compression throat 76 which communicates with air return duct 77 and return port 75 through velocity matched air return vanes 78. Vane combs 79 are interspersed with return vanes 78. Compression throat 76 is in communication with second sorting column 81. Sorting column 81 has a fan 82 in communication with output port 83 and with vortex eliminator vanes 84. Vortex eliminator vanes 84 are in communication with laminar flow vanes 86 which in turn are in communication with the sorting column 81 through deflecting grate 87. Sorting column 81 terminates at its upper end in compression throat 88 which communicates with return duct 89 and return port 90 through velocity matched air return vanes 91.

Referring to FIG. 3, vane combs are interspersed with air return vanes 92. Compression throat 94 is in communication with sorting column 95 which contains a fan 96 which is in communication with output port 97 and vortex eliminator vanes 98. Vortex eliminator vanes are in air communication with laminar flow vanes 99 which are in air communication with sorting column 95 through deflecting grate 101. Sorting column 94 terminates in its upper end in compression throat 102 which communicates through velocity matched air return vanes 103 with return duct 104. Return duct 104 communicates with return port 105. Vane combs 106 are interspersed with air return vanes 103. Compression throat 102 communicates with sorting column 107 which contains fan 108 in communication with output port 109 and vortex eliminator vanes 111. Vortex eliminator vanes 111 are in air communication with sorting column 107 through laminar flow vanes 112 and deflecting grate 113. Sorting column 107 terminates in its upper end in a compression throat 114 which in turn communicates with residue chamber 116. Residue chamber 116 contains a filter 117 which communicates with a return duct 118 (FIG. 7).

Referring to FIG. 4, the air classifier for shredded refuse is shown at 11 with housing 12. Motor drive for air return vanes 66 (FIG. 2) is shown at 66A together with its shaft bearing plate 17. Hopper opening 13 is shown with conveyor belt 47 disposed beneath it carrying sealing vanes 48 above and below it. Conveyor belt 47 is carried by a roller 45 on axle 49 (not visible). Axle 49 (not visible) terminates in bearing plate 14. Drive motor 49A drives axle 49 (not visible) of roller 45. Conveyor belt 47 extends into grooves 20 in the inside surfaces of housing 12. Deflecting grate 69 is shown in proximity to disposal housing 27. Return manifold 70 communicates through air return port 52 with fan 55. Disposal housing 26 is shown horizontally disposed from housing 12. Return duct 118 is shown vertically disposed above return manifold 70.

Referring to FIG. 5, housing 12 is shown carrying drive motor 66A which has a shaft coupled to air return vanes 66 terminating in bearing plate 17. Vane combs

67 are shown interspersed with air return vanes 66. Air return duct 65, shown beneath air return vanes 66, communicates through return port 60 with return manifold 70.

Referring to FIG. 6, drive motor 78A has a shaft carrying air return vanes 78 and terminates in bearing plate 18. Deflection grate 69 is shown within sorting column 68 in proximity with disposal housing 27. Disposal housing 27 has a conveyor belt 121 carried between rollers 122 and 123. Conveyor belt 121 has a plurality of sealing vanes 124. Disposal housing 27 has an exhaust port 126. A small intake blower 127 is disposed within an intake port 128 which communicates with return manifold 70. Return manifold 70 communicates with fan 71 through outlet port 74. Fan 71 has an air communication with vortex eliminator vane 72 which in turn is coupled to sorting column 68 through laminar flow vanes 73 and deflecting grate 69.

Referring to FIG. 7, intake hopper opening 13 is shown in housing 12 exposing conveyor belt 47, and sealing vanes 48. Air return pedestals 44 and 44A support the intake portion of housing 12. Conveyor drive motor 49A, shown carried by housing 12 cooperates in driving conveyor belt 47 by means of internal rollers (not shown) with roller shafts (not shown) terminating in bearing plates 14, 15, 15A, 16 and 16A, respectively. Disposal housing 26 has bearing plate 25 and drive motor 25A. Disposal housing 27 has bearing plates 36, 36A and 36B and a drive motor 27A. Disposal housing 28 has bearing plates 37, 37A and 37B with a drive motor 28A. Disposal housing 33 is shown with bearing plates 42, 42A and 42B and with a drive motor 33A. Disposal housing 34 is shown with bearing plates 43, 43A and 43B and a drive motor 34A. Air return vane drive motors 66A, 78A, 91A, 93A and 103A are shown having their shafts coupled to respective air return vanes (not numbered for clarity), and terminating in bearing plates 17, 18, 19, 23 and 24, respectively. The various compression chambers 64, 76, 94, 102 and 114 are shown within housing 12. The various sorting columns 63, 68, 81, 95 and 107 are also shown disposed within housing 12. Residue chamber 116 is also indicated together with filter removal hatch 46 on one side thereof and return duct 118 around filter 117 communicating with return manifold 70.

Referring to FIG. 8, air return manifold 70 is shown communicating with return port 52 and fan 55. Disposal housing 26 is illustrated in communication with hopper 61 and conveyor 62. Return ports 60, 75, 90 and 105 are shown between output ports 74, 83, 97 and 109, all of which communicate with air return duct 70. Residue chamber 116 is shown with residue access hatch 46A on one side thereof. Fans 71, 82, 96 and 108 are shown in proximity to intake ports 74, 83, 97 and 109 within the bases of sorting column structures 68, 81, 95 and 105.

Referring to FIG. 9, one of the air return vanes and vane comb assemblies is shown having a plurality of air return vanes indicated at 66 with an area of interspersed vane combs shown generally at 67A. Air return vanes are mounted on shaft 80.

Referring to FIG. 10, an air return vane 66A is shown with vane comb 67 in operable proximity therewith.

OPERATION

Referring back to FIG. 1, the shredded refuse, which can be anything from onion skin paper through bristol

board or aluminium strips, is dumped into hopper 13. The disposal housing 27, 28, 29, 31, 32, 33 and 34 dump the classified refuse, starting with the heaviest from housing 27 to the lightest in housing 43. The refuse from housing 26 is the non-classified material which could be intermingled with the shredded refuse and is too heavy to pass through the first classification stage.

Referring to FIGS. 2 and 6, the operation will be explained. After hopper 13 receives the shredded refuse, it is picked up by conveyor belt 47 and passes under inspection port 54 where large, unmanageable parcels of refuse can be moved so that their passage will not interfere with the remaining operation. The conveyor belt 47 lies within upper and lower walls of housing 12 and effects a seal therewith which prevents significant escape of pressurized air from the sorting chamber. Small portions of air that follow the outgoing vanes on the lower track are scavenged by low pressure air return ducts 44 and 44A. Input refuse drops through the initial input chute into a high velocity throat 58 which raises a majority of the input into gross separation area 59. Air for this separation is supplied by return manifold 70 through return port 52 and accelerated by gross separation air fan 55 where it is directed upward into separation area 59 through high velocity throat 58. Heavier refuse which cannot be supported by the vertical air stream falls or slowly settles downward through overweight fraction hopper 61 onto sealed overweight conveyor belt 62 where it is removed from the system through disposal housing 26.

Acceptable refuse fractions are borne up the sorting conduit 63 where a large portion of the rising air mass in this column is removed through velocity matched air return vanes 66 because of compression throat 64. These vanes are rotated as shown at a speed approximating that of the moving refuse particles in compression throat 64. Refuse particles which tend to stick to the surface of vanes 66 are combed off by vane combs 67. Air passing through rotating vanes 66 passes down air return duct 65 and through return port 60 to air return manifold 70.

The acceptable refuse from compression throat 64 is injected at considerable velocity into the first sorting column 68 where a rising air mass of slightly lower velocity than that of area 63 performs the first fine sorting. Air for the first sorting column 68 passes from air return manifold 70 through output port 74, through fan 71 upward through vortex eliminator vanes 72, laminar flow vanes 73 and first fraction deflecting grate 69. Vortex eliminator vanes and laminar flow vanes serve as an air columnater. The first settling refuse fraction is deflected out of the air stream by first fraction deflecting grate 69 and onto conveyor belt 121 within disposal housing 27 and is finally dropped through exhaust port 126.

These actions are repeated in any number of subsequent sorting columns shown as seven in FIG. 1, each subsequent column having a slightly lower velocity of rising air mass. This is illustrated schematically in FIGS. 2, 3 and 8 with the decreasing size of the fans. At the final end a filter chamber 116 receives the output of compression throat 114 but the only air return is through a large filter 117 and a duct 118 to the return

manifold 70.

The details of construction are shown throughout the drawings and have been described fully with reference to each separate figure. Access doors 46 and 46A of residue chamber 116 allow for removal of the filter 117 and for the collection of any debris which slide down the filter.

It should be understood, of course, that the foregoing disclosure relates to only a preferred embodiment of the invention and that it is intended to cover all changes and modifications of the example of the invention herein chosen, for the purposes of the disclosure, which do not constitute departures from the spirit and scope of the invention.

The invention claimed is:

1. An air classifier for material to be sorted on a weight versus surface area basis comprising:
 - a plurality of vertically extending sorting columns;
 - a material input to a first one of said plurality of vertically extending sorting columns;
 - means for creating a rising air mass in said first one of said sorting columns having a velocity amplitude operable for raising a first fraction of said material;
 - a compression throat coupling said first sorting column to a second sorting column at the top portions thereof;
 - means for creating an upwardly moving column of air in said second sorting column having a lower velocity than the column of air in said first sorting column, said upwardly moving column of air having a velocity amplitude operable for raising a second fraction of said material;
 - an air exhaust column disposed in proximity and communicating with said compression throat;
 - a plurality of rotating air return vanes disposed between said compression throat and said air exhaust column; and
 - each of said sorting columns having an output port in a bottom portion thereof for discharging classified material.
2. The air classifier of claim 1 wherein said material input to said first one of said plurality of vertically extending sorting columns comprises:
 - a sealed conveyor means communicating with said first one of said plurality of vertically extending sorting columns.
3. The air classifier of claim 1 wherein each of said output ports associated with each of said sorting columns comprises a sealed conveyor means.
4. The air classifier of claim 1 and further including:
 - an air columnator in the bottom portion of each of said sorting columns for columnating said rising air mass.
5. The air classifier of claim 1 and further including:
 - a plurality of vane combs interspersed with said rotating air return vanes for combing off any material tending to stick to the surface of said rotating vanes.
6. The air classifier of claim 1 and further including:
 - an air return manifold in communication with said air exhaust column and communicating with each of said plurality of vertically extending sorting columns for supplying an air mass thereto.

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