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AIR CLASSIFIER

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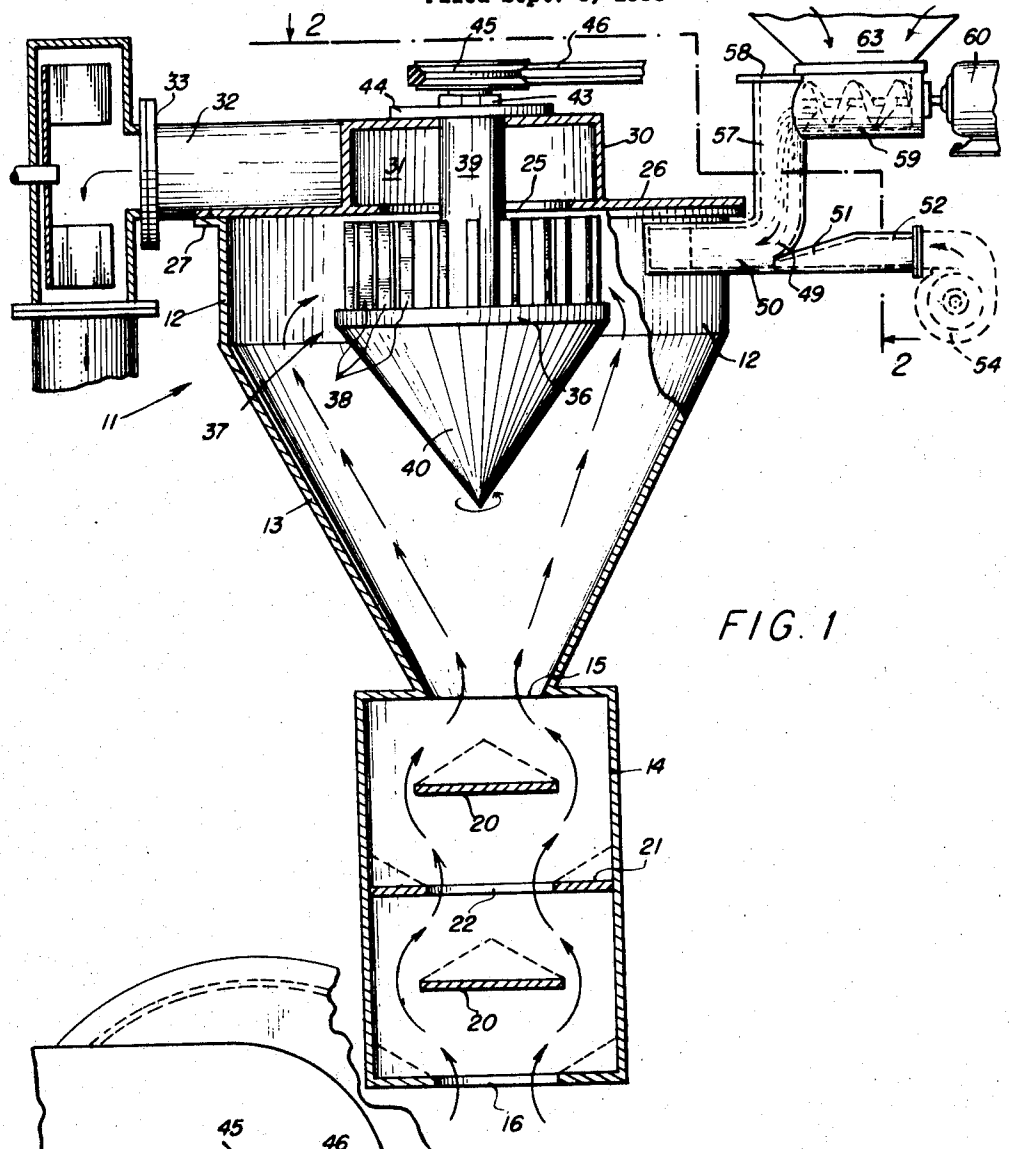

FIG. 1

FIG. 2

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This invention relates to air classifiers, and more particularly is concerned with improvements in classifying machines for obtaining more efficient particle classification.

Heretofore, in rotary centrifugal type classifying apparatus there has been an efficiency which was not as high as might be desired. The major drawback, or aspect, of the poor efficiency in such machines was concerned with the fact that such machines did in fact reject a fairly large percentage of material which was within the size range that it was desired to collect. Thus, there was a considerable waste, in that much material which included the desired sized particles, nevertheless, was carried out and rejected (along with the larger, or undesirable sized particles, of material).

By use of a machine according to the invention, it has been discovered that the efficiency of a rotary classifying machine of the type under consideration, may be increased a substantial amount, so that there is practically no rejection of particles of the material within desired size range.

Thus, it is an object of this invention to provide an improved solid-material particle size classifier which makes use of a standard rotating vane classifier, and in addition thereto includes a particle separating means which cooperates with the rotary vane classifier, so as to eliminate the rejection of material particles having the desired size which may pass through the rotary classifier.

Another object of this invention is to provide an improved material classifier of the rotary centrifugal type, which disperses the material to be classified, while injecting it into the vicinity of the centrifugal classifier. In this manner, the classifying of the material is greatly facilitated and improved since there is a preliminary breaking up or dispersal of the individual particles of the material.

Still another object of the invention is to provide a centrifugal type classifier for solid materials in particle form, which includes in addition to the centrifugal classifying mechanism, a particle dispersing means as well as a particle separating means that is included on the rejection side of the classifier. The combined overall result of this mechanism is to provide for a substantial and unexpected increase in the total efficiency of the classifying operation of the machine.

Briefly this invention is concerned with an improved solid-material particle size classifier. Such classifier comprises a rotating vane means for rejecting particles above a predetermined size, and also tangential injector means for dispersing the fragmentary particles and directing them toward said vane means in a tangential manner, in the direction of rotation of the vanes. The invention also comprises means for causing air to flow radially through said vane means at a predetermined velocity in order to carry particles equal to and less than the predetermined size through the vane means, and comprises separating means located on the rejection side of said vane means for separating out acceptable sized particles and returning them again to the vane means.

The best mode for carrying out the invention, as now contemplated, is illustrated by a given embodiment that is described below, by way of example; and illustrated in the drawings, in which;

Fig. 1 illustrates a longitudinal elevation partly in cross section, of a classifier according to the invention; and

Fig. 2 is a fragmentary plan view, partially broken away to show the interior of the top structure, taken along the lines 2—2 of Fig. 1.

Fig. 1 shows the entire classifying machine which includes a housing 11 that is made up of a short cylindrical upper portion 12 and a frusto-conical lower portion 13. At the bottom of the frusto-conical portion 13 there is an integrally attached cylindrical conduit 14 which has openings 15 and 16 at the top and bottom thereof, respectively. Within the enclosed column formed by conduit 14, there is a plurality of axially aligned discs 20 which may be supported in any desired manner, such as by means of relatively thin radial supports (not shown) which extend outward to the walls of the conduit 14. Located mid-way between each pair of discs 20 there is a ring, or annular shelf, 21 which is tightly fastened to, or integrally formed with, the walls of the conduit 14. This ring defines a central hole or opening 22 which is of a smaller diameter than that of the discs 20, so that there is a tortuous path for the passage of air currents through the conduit 14 as indicated by the arrows.

The top of the upper portion 12 of housing 11 is closed (except for a central, or axially located hole 25) by means of a flat sheet material top 26 that is attached to the upper portion 12 in any convenient manner such as by means of welding to a laterally extending flange 27 at the top edge of the upper portion 12. Integrally formed with the top 26, there is an enclosure 30 which extends upward over the hole 25, forming a chamber 31 in the form of a volute that has an opening tangentially therefrom through a pipe 32. The pipe 32 has a flange 33 to which there may be attached any feasible suction fan, such as the well-known type of suction fan shown, for drawing air in desired quantities and velocities, through the classifier housing 11.

Coaxially located within the housing 11, at the top thereof, there is a rotor 37 that includes a plurality of relatively tall narrow radial vanes 38 attached at the periphery of a circular disc 36. Vanes 38 are flat and relatively thin, and are attached along the bottom edges thereof (when viewed as shown in Fig. 1) to the disc 36 in any convenient manner, e.g. by welding. The disc 36 is securely attached to a central shaft or hub 39 for rotation therewith. The lower part of the rotor 37 includes a conical member 40 which is securely fastened to the disc 36, underneath the vanes 38. This conical member, or baffle 40 acts to direct the flow of air smoothly out, near the periphery of the chamber within the housing 11.

It may be noted that the same function may be carried out by structure equivalent to the conical member 40, e.g. any similar rounded or tapered baffle structure which is supported beneath the disc 36 which carries rotating vanes 38 of the rotor.

The entire rotor 37 is supported for rotation by a thrust bearing 43 which is carried on plate 44, which in turn, rests on the upper flat surface of enclosure 30. Attached securely to an extension of the shaft 39, for rotation therewith, there is a pulley 45 which may be driven in rotation from any convenient power source (not shown) by means of a V belt 46, illustrated.

In order to introduce the particles of solid material that are to be classified, there is an injector tube 50 which extends through the side wall 12 of the housing 11 in a tangential manner, relative to the vanes 38 of

the rotor 37. The injector tube 50 has a nozzle 51 attached to the bottom of an elbow bend 49 therein. Nozzle 51 is constructed integrally with an air inlet pipe 52 which has a diameter nearly as large as the diameter of tube 50, so that a predetermined quantity of air will tend to enter through this pipe 52. The nozzle 51 is formed by a reduction in the cross sectional area of the passage within pipe 52, so that a relatively high velocity of air flow will be had at the outlet of the nozzle 51. This outlet forms an opening 53 (see Fig. 2) at the juncture of the passage within nozzle 51 and the elbow bend 49 of the tube 50.

It is to be noted that if desired, there may be employed an auxiliary blower 54 (which is shown in dashed lines) for introducing the air which flows through pipe 52 into nozzle 51. In the absence of such an auxiliary blower 54, air is merely drawn in through the pipe 52 by reason of the suction created as the fan attached to outlet pipe 32 draws air through the entire housing 11.

There is an upstanding extension 57 of the injector tube 50 that connects with the elbow bend 49 of the tube 50, and that may be described as a feed tube. At the top of feed tube 57 there is an enclosing lid or plate 58 to keep air from entering the tube 57. Near the top of the tube 57 and connected to one side thereof, is a worm-feed mechanism (illustrated in dashed lines). The worm is rotated by any convenient source of power, such as an electric motor 60, as illustrated. Above the worm feed housing 59, there is attached a bin or hopper 63 which contains the material that is to be fed out via the worm feed into the feed tube 57.

Operation

In order to make clear the cooperation between various elements of the classifier according to this invention, the operation of the illustrated machine will be described. Beginning at the hopper 63, material is pushed into the feed tube 57 by means of a standard type of worm feed such as that illustrated. The material thus fed falls down feed tube 57, into the path of a relatively high velocity jet of incoming air, that is being introduced via nozzle 51. Consequently, the material is forceably picked up and carried out, or ejected from the opening at the end of the injector tube 50. In this manner the particles of material to be classified are considerably dispersed as they are introduced into the chamber within the housing 11.

It is to be noted that the material as it is ejected from the injector tube 50 through the housing 11 is directed tangentially of the vanes 38 of rotor 37. Furthermore, the direction of such tangential introduction thereof, is chosen to agree with the direction of rotation of rotor 37, so that the vanes 38 are traveling in the same direction as the particles when they (the particles) reach the vicinity of the rotor vanes 38. This avoids any high speed contact with the faces of the vanes 38 which would tend to coat the surfaces that are acting to centrifugally reject oversized particles and thus would impair the classifying action.

The particles are caught up by the air currents within housing 11, and are drawn radially through the rotor 37, between the vanes 38 and then upward through the opening 25 into chamber 31 and out via pipe 32 to be collected. However, only those particles which are below a predetermined size, as determined by the various factors which include material density and particle configuration, are drawn through the rotating vanes 38. The particles which are above this predetermined size, will be returned radially outward against the flow of the air through the housing 11 (along the surface of the vanes 38) by reason of the centrifugal force involved. The oversized particles thus rejected at the rotor 37 will fall by gravity against the rising air currents within the housing 11, and will enter the separating column which is formed by the interior of conduit 14.

Here in conduit 14, these particles are subjected to turbulent action in conjunction with increased velocity air flow. This action is created by the overlap between the edges of the discs 20 and the hole 22, so that the particles cannot fall freely out of the bottom opening 16. Therefore, this action tends to cause a separation of acceptable sized particles which may be adhering to the larger rejected particles, or had been deflected downward. When such acceptable sized particles are separated from the larger particles, they (the small particles) are caught by the rising currents of air and carried upward within the housing 11, again to be drawn through the rotating vanes 38 of the rotor 37. In this manner only those particles which are above the acceptable size limits will be finally rejected by the classifier, and these may be received below the opening 16 in any convenient manner, for disposal as desired.

It is pointed out that the design of the various dimensions will determine relative velocities of air flow as well as the velocities per se for given pressures applied. It has been determined that for best operation, the upward velocity in the housing 11 should be at least double the terminal velocity of the maximum particle size that is to be accepted. And, the upward velocity of the air in the fractionating column 14 should be four times the same terminal velocity.

Of course, the same principles would apply if gases other than air were to be used in place of the air described. Consequently, it is not intended to limit the invention in any way by using the term air in this description, and the term air may be read as meaning any feasible gas, throughout.

It may be noted that the particles of material in falling down through the separating column within conduit 14 will tend to build up on the upper surface of the discs 20 and the rings 21, as indicated by the broken lines. Consequently, should it be desired to eliminate the small preliminary build up of such particles of material, the upper surface of these discs 20 and the ring 21 may be shaped to create a sloping surface for aiding the particles to roll off and continue down through the fractionating column.

While a given embodiment of the invention has been described in considerable detail in accordance with the applicable statutes, this is not to be taken in any way as limiting the invention, but merely as being descriptive thereof.

It is claimed:

1. An improved solid-material particle size classifier comprising rotating vane means for rejecting particles above a predetermined size, means for directing particles to be classified toward said rotating vane means in a tangential manner, means for causing air to flow radially through said vane means at a predetermined velocity in order to carry particles equal to and less than the predetermined size through the vane means, separating means located on the rejection side of said vane means for separating out acceptable sized particles and returning them again to the vane means and an enclosure surrounding said vane means and connecting the separating means with the vane means.

2. An improved solid-material particle size classifier comprising rotating vane means for rejecting particles above a predetermined size, means for directing particles to be classified toward said rotating vane means in the direction of the rotation of the vanes, means for causing air to flow radially through said vane means at a predetermined velocity in order to carry particles equal to and less than the predetermined size through the vane means, upstanding conduit means having baffles therein, an enclosure surrounding said vane means and openly connecting with said conduit means at the top thereof, the bottom of said conduit means having an opening for discharging rejected particles and for permitting an upward flow of air.

3. An improved solid-material particle size classifier comprising centrifugal classifying means including a rotor having radial vanes near the periphery thereof, said rotor being mounted with its axis of rotation vertical, housing means surrounding said rotor to provide a path for air to flow radially through said rotor between said vanes, depending turbulence eliminating means on the lower side of said rotor to aid in smoothly directing the flow of air to the periphery of said rotor, means for directing the material to be classified toward said rotor in a tangential manner and in the direction of the rotation of the vanes, vertical conduit means having baffles therein and including an opening at the top and bottom thereof, the top of said conduit means being connected with the bottom of said housing means for receiving rejected material as it falls, said conduit means and baffles acting to separate said rejected material and return substantially all of the acceptable size particles to said rotor for passage therethrough.

4. An improved solid-material particle size classifier comprising rotating vane means for rejecting particles above a predetermined size, tangential injector means for dispersing particles to be classified and directing them toward said vane means in a tangential manner in the direction of rotation of the vanes, means for causing air to flow radially through said vane means at a predetermined velocity in order to carry particles equal to and less than the predetermined size through the vane means, separating means located on the rejection side of said vane means for separating out acceptable sized particles and returning them again to the vane means and housing means having an opening therein smaller than the diameter of the rotating vanes surrounding said vane means to provide a path for air to flow radially through said vane means, the separating means being connected to said housing means.

5. An improved solid-material particle size classifier comprising rotating vane means for rejecting particles above a predetermined size, tangential injector means for dispersing the particles and directing them toward said vane means in a tangential manner in the direction of rotation of the vanes, means for feeding the material into said injector means from a supply of material, means for causing air to flow radially through said vane means at a predetermined velocity in order to carry particles equal to and less than the predetermined size through the vane means, upstanding conduit means having baffles therein, an enclosure surrounding said vane means and connecting with said conduit means at the top thereof, the bottom of said conduit means having an opening for discharging rejected particles, said means to cause radial flow including an opening in the top of said enclosure of smaller diameter than the rotating vanes whereby air and selected particles are caused to pass radially through said vanes.

6. An improved solid-material particles size classifier comprising centrifugal classifying means including a rotor having radial vanes near the periphery thereof, said rotor being mounted with its axis of rotation vertical, housing means surrounding said rotor to provide a path for air to flow radially through said rotor between said vanes, means for causing air to flow radially through said vane means at a predetermined velocity in order to carry particles equal to and less than the predetermined size through the vane means, depending turbulence eliminating means on the lower side of said rotor to aid in smoothly directing the flow of air to the periphery of said rotor, tangential injector means for dispersing particles to be classified and directing them toward the vanes on said rotor, separating means connected to said housing means and located below said rotor to catch rejected particles and return any acceptable sized particles again to said classifying means.

7. An improved solid-material particle size classifier comprising centrifugal classifying means including a rotor having radial vanes near the periphery thereof, said rotor being mounted with its axis of rotation vertical, housing means surrounding said rotor to provide a path for air to flow radially through said rotor between said vanes, depending turbulence eliminating means on the lower side of said rotor to aid in smoothly directing the flow of air to the periphery of said rotor, an injector tube directed tangentially of said radial vanes, means for feeding the material into said injector tube from a supply of material, an injector nozzle directed longitudinally through said injector tube in the same direction, means for causing high velocity air flow through said injector nozzle to disperse the particles of material while ejecting them out of said injector tube in the vicinity of said vane means and traveling in the same direction, separating means connected to said housing means and located below said rotor to catch rejected particles and return any acceptable sized particles again to said classifying means.

8. An improved solid material particle size classifier comprising centrifugal classifying means including a rotor having radial vanes near the periphery thereof, said rotor being mounted with its axis of rotation vertical, housing means surrounding said rotor to provide a path for air to flow radially through said rotor between said vanes, depending turbulence eliminating means on the lower side of said rotor to aid in smoothly directing the flow of air to the periphery of said rotor, an injector tube directed tangentially of said radial vanes, an upstanding feed tube connected to said injector tube, a feed hopper for holding a supply of the material to be classified, enclosed means for feeding the material into said feed tube near the top thereof from the bottom of said hopper, an injector nozzle directed longitudinally through said injector tube, means for causing high velocity air flow through said injector nozzle to disperse the particles while ejecting them out of said injector tube in the vicinity of said vane means and traveling in the same direction, separating means connected to said housing means and located below said rotor to catch rejected particles and return any acceptable sized particles again to said classifying means.

9. An improved solid-material particle size classifier comprising centrifugal classifying means including a rotor having radial vanes near the periphery thereof, said rotor being mounted with its axis of rotation vertical, housing means surrounding said rotor to provide a path for air to flow radially through said rotor between said vanes, a depending cone integrally attached to said rotor for rotation therewith having its maximum diameter located adjacent to the bottom edge of said vanes, an injector tube directed tangentially of said radial vanes, an upstanding feed tube connected to said injector tube, a feed hopper for holding a supply of the material to be classified, enclosed means for feeding the material into said feed tube near the top thereof from the bottom of said hopper, an injector nozzle directed longitudinally through said injector tube in the same direction, means for causing high velocity air flow through said injector nozzle to disperse the particles of material while ejecting them out of said injector tube in the vicinity of said vane means and traveling in the same direction, upstanding conduit means having baffles therein and including an opening at the top and bottom thereof, the top of said conduit means being connected with the bottom of said housing means for receiving rejected materials as it falls, said conduit means and baffles acting to fractionate said rejected material and return substantially all of the acceptable size particles to said rotor for passage therethrough.

References Cited in the file of this patent

UNITED STATES PATENTS

1,145,903	Lehrack	July 13, 1915
1,962,450	Lykken	June 12, 1934
2,338,779	Mutch	Jan. 11, 1944
2,361,758	De Fligue	Oct. 31, 1944
2,758,713	Hardinge	Aug. 14, 1956

FOREIGN PATENTS

671,941	Great Britain	May 14, 1952