March 7, 1961 C. R. DELAGRANGE ET AL 2,973,993

APPARATUS FOR FEEDING SOLIDS

Filed March 25, 1958

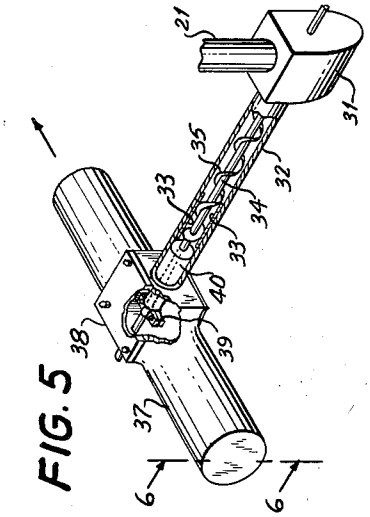


FIG. 5

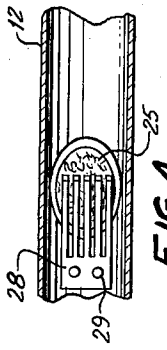


FIG. 4

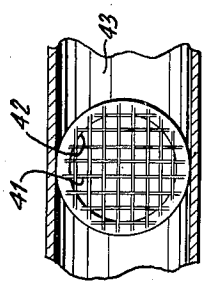


FIG. 7

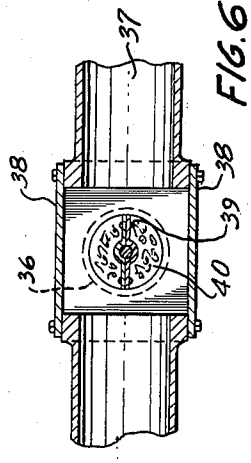


FIG. 6

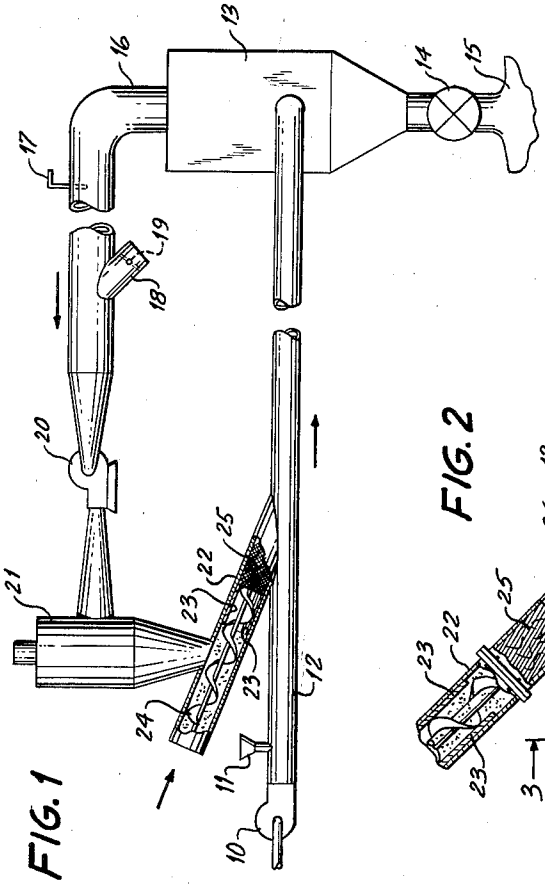


FIG. 1

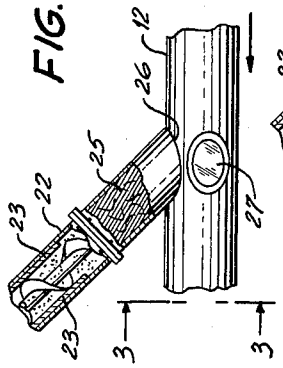


FIG. 2

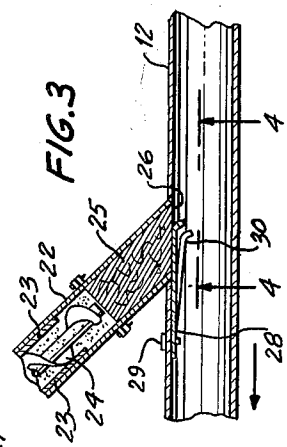


FIG. 3

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APPARATUS FOR FEEDING SOLIDS

Carl R. Delagrange, Ripplemead, and Gerard F. Meehan, Blacksburg, Va., assignors to Celanese Corporation of America, New York, N.Y., a corporation of Delaware

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16 Claims. (Cl. 302—59)

This invention relates to an apparatus for feeding solid particles, and more particularly to an apparatus for feeding such particles into a zone which it is desired to isolate from the atmosphere.

In the operation of a plant for esterifying wood pulp cellulose, sheets of the wood pulp are shredded and the fibers are pneumatically conveyed to a cyclone separator, the solids dropping down into an esterification vessel while the conveying air passes upwardly and out. Small wood pulp particles formed in the shredding, hereinafter referred to as "cellulose dust," do not drop out of the air stream in the cyclone separator but rather are carried out therewith.

It is an object of the invention to provide an apparatus for recovering this dust and converting it into a re-usable form.

It is a further object of the invention to provide an apparatus for positively feeding finely divided particles to a zone which it is desired to maintain isolated from the atmosphere.

Another object of the invention is to provide an apparatus for collecting airborne industrial dusts and fines, compacting said fines into a plug and comminuting said plug to form agglomerates of said fines.

Other objects and advantages of this invention will be apparent from the following description and claims.

In accordance with one aspect of the present invention, the dust-laden air is passed into a dust-precipitating device and the deposited dust is fed to a screw conveyor disposed in a line communicating with the conduit through which air and shredded wood pulp are conveyed to the cyclones. The screw conveyor compacts the dust into a plug which extends into the conveying conduit and which is broken off or abraded away by the material moving through the conduit, the particles into which the plug is subdivided being sufficiently large to drop out of the air stream upon reaching the cyclones.

The invention will now be described more specifically with reference to the accompanying drawing, wherein:

Fig. 1 is a schematic view, broken away in part, of the over-all apparatus for collecting, compressing and discharging industrial dusts,

Fig. 2 is a detailed view, broken away in part, of the screw compressor of Fig. 1,

Fig. 3 is a vertical section through the compressor of Fig. 2,

Fig. 4 is a section taken on line 4—4 of Fig. 3.

Fig. 5 is a schematic view of another embodiment of compressing and discharging apparatus with a portion of the conveying conduit broken away,

Fig. 6 is a vertical section through the transport conduit, taken on line 6—6 of Fig. 5 and

Fig. 7 is a plan view of a modified structure which can extend across the aperture affording communication between the line housing the screw conveyor and the transport conduit.

Referring now more particularly to the drawing, in Fig. 1 there is shown a centrifugal blower 10 for pneumatically forwarding a subdivided material supplied at 11 to a conduit 12. The conveying gas and subdivided material, e.g. air and wood pulp, enter a cyclone separator 13 and the large wood pulp particles fall and drop through a valve 14 into a vessel such as a reactor 15. The conveying gas along with fine particles or dust leave the separator and enter a pipe 16. A slide gate damper 17 controls the volume of air at a point where only finely divided dust is handled in the air, the large agglomerates having already been removed. An open-ended branch 18, provided with a conventional pivoted damper 19, communicates with pipe 16 and controls the flow of outside air into the pipe.

The dust laden air is pulled through pipe 16 by a blower 20 and is discharged into a high efficiency dust collector 21 of the mechanical or bag type which will remove small solid particles. Air leaves at the top of collector 21 and the dust drops downward into a line 22 provided along a portion of its inside with longitudinally extending brass ribs 23 to improve the feeding action of a screw 24 which rotates in line 22. As seen more clearly in Figs. 2, 3 and 4, screw 24 terminates short of the end of line 22 and the dust is compacted beyond the screw into a plug 25.

The inclined line 22 communicates across an aperture 26 with the transport conduit 12 through which the shredded wood pulp is pneumatically conveyed for use in processing, such as esterification. As shown in Fig. 2, the conduit 12 is provided with a sight glass 27 adjacent aperture 26. A retainer 28 (Figs. 3 and 4) is secured to the conduit 12 by bolts 29, the retainer being provided with resilient fingers 30 extending at least partially across aperture 26. The free ends of the fingers may be curved away from the screw conveyor.

In operation, the plug 25 grows and moves toward aperture 26 as screw 24 rotates, the retaining fingers 30 providing resistance to compact the plug and thereby to form a gas-tight seal which prevents the gas within conduit 12 from venting to the atmosphere by way of line 22. The fingers 30 are resilient and will bend away slightly, e.g. up to about 30 degrees, so as to permit the plug 25 to enter the conduit 12. As a result of the reduced influence of fingers 30 on the plug as it enters conduit 12 and as a result of the action of the air and solids passing through conduit 12, the plug 25 partially falls away and is partially abraded away to be carried along in conduit 12. The material which breaks off from plug 25 comprises aggregates of many fine particles, which aggregates for the most part are sufficiently large in size or cling to larger agglomerates so that they will not pass out of separator 13 with the conveying gas.

In Fig. 5 there is shown a modified apparatus for forming and retaining a plug. Dust from collector 21 falls into a hopper 31 communicating with a line 32 provided with longitudinal ribs 33, a shaft 34 extending through the line 32 and hopper 31 and being supported for rotation by conventional means (not shown). A helical thread 35 is connected with shaft 34, terminating short of where line 32 communicates across an aperture 36 with a transport conduit 37, the latter being provided with top and bottom sight glasses 38.

The end of shaft 34 extends transversely through the wall of conduit 37. A shave-off 39 comprising a pair of members bolted to each other is secured to shaft 34 within conduit 37. The span of the shave-off is equal to the diameter of the thread 35 and the leading end of the plug 40 which forms is continuously shaved off as shave-off 30 rotates.

Fig. 7 shows another modification wherein the retainer comprises a wide-mesh screen or grate 41 secured across the aperture 42 through which a screw conveyor line (not shown) communicates with a transport conduit 43.

The screen 41 provides sufficient resistance to compact the plug but the plug is subdivided in passing through the screen. Alternatively, threaded bolts projecting radially through the wall of the screw conveyor line can be employed to retain the plug and to aid in its subdivision. The resistance which determines the degree of compaction can thus be adjusted by advancing the bolts further into the line or by partially withdrawing them from the line.

In practice it has been found that particularly good results are achieved when the screw conveyor discharges perpendicularly into the transport conduit and both are arranged in a horizontal plane.

While the invention has been described with reference to feeding of a wood pulp dust, it can be used with any fine material capable of being compacted to a plug which resists passage of gas therethrough. The plug thus forms a seal and permits operation without mixing between the gas behind the screw and the gas within the transport conduit, irrespective of which is under greater pressure.

It is to be understood that the foregoing detailed description is merely given by way of illustration and that many variations may be made therein without departing from the spirit of our invention.

Having described our invention, what we desire to secure by Letters Patent is:

1. An apparatus for efficient feeding of subdivided material to a vessel comprising, in combination, means for pneumatically conveying said subdivided material to said vessel, means for separating conveying gas together with fine particles of said subdivided material from other particles entering said vessel, means for recovering said fine particles, means for feeding said recovered fine particles back to said conveying means, and means for compacting said fine particles into a plug prior to reaching said conveying means and for subdividing said plug into aggregates larger than said fine particles.

2. An apparatus as set forth in claim 1 wherein said means for feeding said recovered fine particles comprises a screw conveyor, and said means for compacting said fine particles comprises retaining means extending at least partially across the path of advance of said plug.

3. An apparatus as set forth in claim 2 wherein said screw conveyor and said conveying means both extend in a horizontal plane.

4. An apparatus as set forth in claim 2 wherein said screw conveyor discharges perpendicularly into said conveying means.

5. An apparatus as set forth in claim 2 wherein the retaining means comprises means for shaving said plug as said plug advances.

6. An apparatus as set forth in claim 5 wherein said screw conveyor comprises a helical thread on a shaft which extends beyond said thread in the direction of advance of said particles, said shaving means being disposed on said shaft for rotation therewith.

7. An apparatus as set forth in claim 2 wherein the retaining means comprises a plurality of resilient fingers extending across the outlet of said line.

8. An apparatus as set forth in claim 2 wherein the retaining means comprises a grate through which said plug must pass, said plug thereby being subdivided into aggregates of said fine particles.

9. An apparatus as set forth in claim 2 wherein the inlet of said screw conveyor is higher than the outlet and said screw conveyor discharges into said conveying means at an acute angle.

10. The apparatus of claim 1 wherein said means for feeding said fine particles comprises a line having an inlet through which said fine particles enter and an outlet through which they leave, a screw conveyor disposed within said line for rotation to advance said fine particles from said inlet to said outlet, said screw conveyor terminating short of said outlet, and retaining means spaced from said screw conveyor and impeding advance of said fine particles beyond said screw conveyor, thereby causing said fine particles to compact into a plug, said retaining means comprising a plurality of resilient fingers fixed at one end and extending across the outlet of said line at their other ends.

11. The apparatus of claim 1 wherein said means for feeding said fine particles comprises a line having an inlet through which said fine particles enter and an outlet through which they leave, a screw conveyor disposed within said line for rotation to advance said fine particles from said inlet to said outlet, said screw conveyor terminating short of said outlet, and retaining means spaced from said screw conveyor and impeding advance of said fine particles beyond said screw conveyor, thereby causing said fine particles to compact into a plug, said retaining means comprising a grate through which said plug must pass, said plug thereby being subdivided into aggregates of said fine particles.

12. An apparatus for efficient feeding of subdivided material to a vessel comprising, in combination, a conduit for pneumatically conveying said subdivided material to said vessel, means for separating the conveying gas together with fine particles of said subdivided material carried along thereby from other particles entering said vessel, means for recovering said fine particles and for feeding them to a line which communicates with said conduit, a screw conveyor in said line terminating before said conduit, and retaining means impeding the advance of said particles from said line to said conduit, thereby causing said particles to compact into a plug.

13. An apparatus as set forth in claim 12 wherein the retaining means comprises a plurality of resilient fingers extending across the outlet of said line.

14. An apparatus as set forth in claim 12 wherein the retaining means comprises a grate through which said plug must pass, said plug thereby being subdivided into aggregates of said fine particles.

15. An apparatus as set forth in claim 12 wherein the retaining means comprises means for shaving said plug as said plug advances.

16. An apparatus as set forth in claim 15 wherein said screw conveyor comprises a helical thread on a shaft which extends beyond said thread in the direction of advance of said particles, said shaving means being disposed on said shaft for rotation therewith.

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