June 1, 1954 N. J. LOCKHART 2,679,933

APPARATUS FOR SEPARATING AIRBORNE ASBESTOS MATERIAL

Filed April 24, 1950 2 Sheets-Sheet 1

Fig. 1.

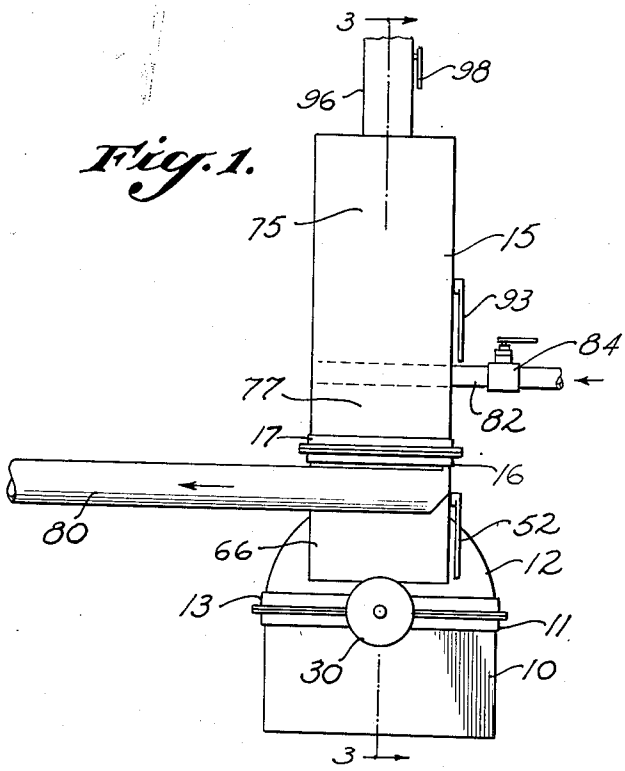
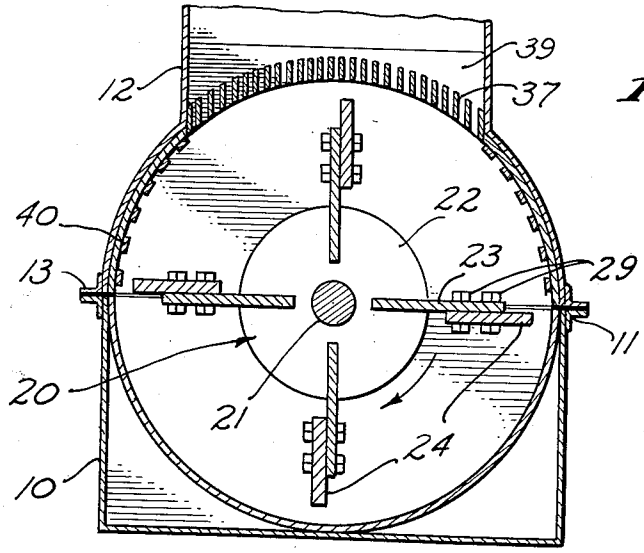


Fig. 2.



NATHAN J. LOCKHART
INVENTOR.

BY

Fulwider & Mattingly
ATTORNEYS

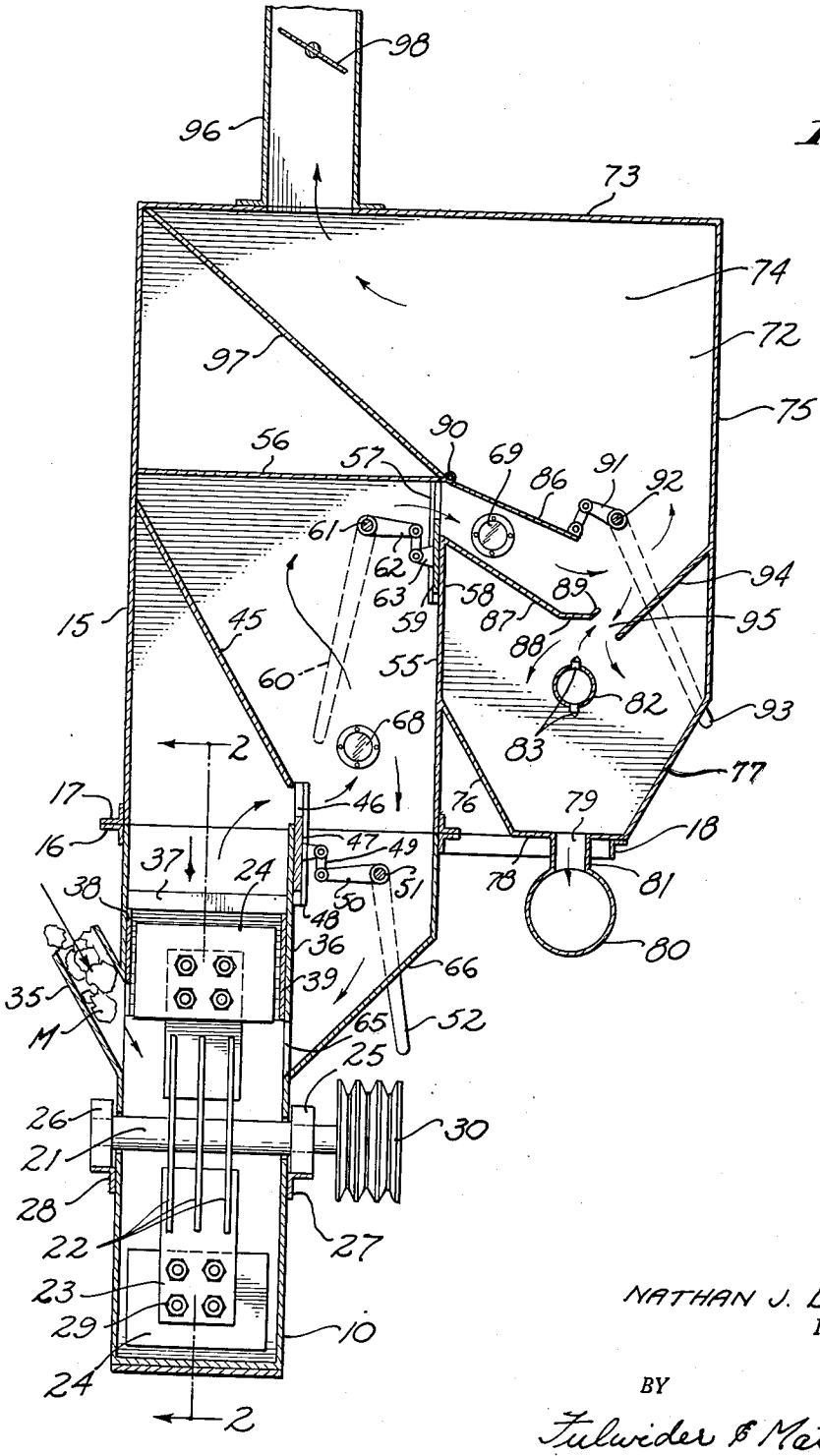
June 1, 1954 N. J. LOCKHART 2,679,933

APPARATUS FOR SEPARATING AIRBORNE ASBESTOS MATERIAL

Filed April 24, 1950

2 Sheets-Sheet 2

Fig. 3.



NATHAN J. LOCKHART
INVENTOR.

BY

Fulwider & Mattingly
ATTORNEYS.

Patented June 1, 1954

2,679,933

UNITED STATES PATENT OFFICE

2,679,933

APPARATUS FOR SEPARATING AIRBORNE ASBESTOS MATERIAL

Nathan J. Lockhart, La Moine, Calif.

Application April 24, 1950, Serial No. 157,718

5 Claims. (Cl. 209—139)

1

My invention relates generally to an apparatus for processing fibrous material, and more particularly to an apparatus for separation of minerals such as asbestos from a parent rock.

In order to fully understand the function of the apparatus it is necessary to consider briefly the nature of asbestos as distinguished from other more common ores. Asbestos suitable for commercial use is found in the form of crystalline fibers imbedded in certain types of stratified rock. The value of the product is dependent upon the separability and length of the fibers, which are subsequently spun and manufactured into sheets of insulating material. For these reasons, conventional grinding and crushing processes using water to promote the grinding are impractical, as they retard the separation of the fibers and destroy their length. Commercial operations have heretofore depended largely upon screen separation after an initial rough crushing. To produce a relatively pure product by such a method, it is necessary to screen the ore many times, and the production costs are consequently high.

I have discovered that it is possible to produce a relatively pure and fibrous asbestos by air flotation of the mixture of asbestos and rock particles, and a subsequent separation of the rock from the fibrous asbestos. This may be done in a continuous operation for which purpose I have constructed an apparatus that requires a minimum number of operators and is otherwise economical.

Briefly described, the apparatus constructed according to my invention employs as shattering means a plurality of paddles adapted to rotate rapidly about a horizontal axis within a cylindrical housing. Raw ore is fed into the housing and is shattered by the impact of the rotating paddles. The mixture of shattered rock and asbestos fibers is discharged vertically through an opening in the cylindrical wall of the housing, being forced out by a blast of air created by the centrifugal blower action of the rotating paddles. As the material passes upwardly, it goes through an adjustable throat which controls the air blast, and accordingly the particle size in the mixture. An adjacent by-pass chute returns oversize particles to the rotor-housing where they are reshattered. The mixture at this state of the process consists of loose rock particles and loose fibers of asbestos. A series of sharply angled deflection passageways then cooperate with the air blast, to separate the relatively light fibers from the rock particles. The asbestos is

2

carried upwardly for further processing, and the waste rock falls and is carried away by an exhaust system. As can be understood, the operation is rapid and continuous, resulting in a low production cost.

An object of my invention is to provide an apparatus which separates the shattered material according to size, returning all insufficiently shattered material for reprocessing.

It is also an object of my invention to provide air flotation passageways that may be quickly and easily adjusted to control the size of the particles of shattered material which are discharged.

Still other objects of my invention are to provide means for separating the crystalline fibers of asbestos from the rock particles, and to provide means for carrying the waste rock from the apparatus.

A still further object of my invention is to provide means for accurate control of the separating process which are easily adjustable to variations in the raw ore.

These and other objects and advantages of my invention will become apparent from the following detailed description of a preferred form thereof, and from an inspection of the accompanying drawing in which:

Fig. 1 is a rear elevation of a preferred form of my improved apparatus;

Fig. 2 is a partial cross-section taken along the line 2—2 of Fig. 3; and

Fig. 3 is a vertical section taken substantially along the lines 3—3 of Fig. 1.

Referring now to the drawings, the numeral 10 designates a lower base or housing section of generally rectangular box-like shape, having a horizontal attachment flange 11 welded around its upper edge. Supported on the base 10 is a central housing section 12, which has an attachment flange 13 welded to its lower edge to mate with and be secured to the flange 11. The central housing 12 is generally box-shaped with open top and bottom, and has flat vertical front and back walls, joined to side walls that are partially cylindrical and partially vertical. Mounted on the top of the central housing section 12 is an enlarged generally rectangular upper housing 15 which overhangs the rear walls of the central section. A second pair of attachment flanges 16 and 17 are provided on the adjacent edges of the upper housing 15 and the central housing 12 respectively, to secure these members together. A suitable brace 18 may also extend rearwardly from the junction to the flanges 16 and 17 to

support the overhanging portion of the upper housing 15, as is seen in Fig. 3.

Mounted for rotation with the enclosure formed by the lower housing 10 and the central housing 12, is a hammer means formed as a multiple bladed rotor 20. The rotor 20 has an axle 21 with three spaced circular discs 22 mounted coaxially thereon. Four radial projecting blade supports 23 are joined to the discs 22 and each has bolted thereon a blade 24 which is disposed parallel to the axle 21. The ends of the axle 21 are journaled in a pair of pillow block bearings 25 and 26 which are supported by a pair of outwardly projecting flanges 27 and 28 welded to the front and back walls of the lower housing section 10. The flanges 27 and 28 are positioned to substantially center the axle 21 within the enclosure formed by the housing sections 10 and 12.

The rotor 20 is adapted to rotate clockwise as viewed in Fig. 2, and the blades 24 are removably fastened on the forward side of the support 23 by means such as bolts 29 so that they may be quickly replaced. To drive the rotor 20, a multiple pulley 30 is secured to the rear end of the axle 21 as is best seen in Fig. 3. The pulley 30 is adapted to receive a number of V belts for power connection to a suitable driving source (not shown). The entire structure thus described is capable of considerable modification without departing from the scope of my invention.

On the front face of the central housing section 12 of the bearing 20 is an inclined loading chute 35 discharging into the interior of the housing. Material M in the form of raw ore is fed into the loading chute 35 and enters the rotor chamber in position to be struck by the rotating blades 24. The impact of the blades 24 on the material M shatters the ore and exposes the fibers of asbestos. The mixture of rock particles and asbestos is then carried around the housing and discharged upwardly to an opening top of the central housing 12. The rotating blades or paddles 24 act as a centrifugal blower and create an air blast to force the material upwardly. A vertical baffle 36 is positioned within the central housing section 12 adjacent the rear edges of the blades 24, and extends upwardly to define with the front wall of the housing a discharge opening through which the material passes.

Extending across the discharge opening of the section 12 is a grate consisting of a plurality of flat bars 37 welded, edge up, between a pair of plate-like supports 38 and 39 and defining passageway therebetween. To further promote the shattering and reduction of the material carried around the interior of the rotor housing, a series of striker bars 40 may be welded along the interior of the cylindrical portion of the central housing section 12, as seen in Fig. 2.

In the upper housing section 15 a flat baffle 45 slants downwardly from the forward wall to terminate near the upper edge of the vertical baffle 36. The opening between these baffles defines a throat 46 through which the material carried upwardly by the air blast passes. On the rear face of the baffle 36 is a sliding door or gate 47 to adjust the size of the throat 46. Vertical tracks 48 guide the outer edges of the gate 47, and a bracket 49 extends rearwardly from the latter for a connection to an adjusting means. The bracket 49 is pivotally connected to a crank-linkage 50 mounted on a horizontal shaft 51. The outer end of the shaft 51 carries a manual adjusting handle 52 disposed outside of the central

housing section 12, as is shown in Fig. 3. The crank-linkage 50 slidably moves the gate 47 against the baffle 36 while the handle 52 is adjusted to the desired angular position.

The sharp change of direction made by the upwardly moving material in passing through the throat 46 causes many of the heavier rock particles to be centrifugally displaced from the air blast and fall back through the grating bars 37 to be reprocessed. As can be understood, the loose fibers of asbestos are better supported by the air blast, and these together with the smaller rock particles continue upwardly within the upper housing section 15. By adjustment of the gate 47, the constriction of the throat 46 may be varied to change the velocity of the air blast in the area. This change in air velocity determines the relative fineness of the particles which will be supported by the air blast, and may be easily varied for different types of raw ores.

The housing section 15 extends upwardly and rearwardly a substantial distance and has a partial vertical dividing wall or baffle 55 spaced rearwardly from the throat 46. An additional overhanging portion extends rearwardly beyond the wall 55 to form a second enclosure or separation chamber 72, as will later be described. A horizontal baffle or wall 56 extends from the front wall of the section 15 to terminate near the upper edge of the wall 55 and form a discharge throat 57. A second gate 58 similar to the gate 47 is movable vertically to adjust the constriction of the throat 57 being guided by vertical tracks 59 mounted on the forward face of the vertical wall 55. To adjust the gate 58, I provide an operating handle 60 on the outside of the housing 15, as is shown in the phantom outline of Fig. 3. The handle 60 is mounted on a horizontal shaft 61 connected by a crank-linkage 62 to a projecting bracket 63 on the forward side of the gate 58. The angular position of the handle 60 thus determines the vertical position of the gate 58. As the air blast carrying the material upwardly makes a second sharp change of direction to pass through the throat 57, still more of the rock particles are deflected and fall, while the lighter asbestos fibers and the smaller rock particles continue.

In order to return such particles as are too large to be carried through the throat 57, an opening 65 is formed in the back of the wall of the central housing section 12 in a similar and opposite position to the feed chute 35. A slanted wall 66 extends upwardly from beneath the opening 65 to join the vertical wall 55, and form a funnel-like chute which directs the material downwardly into the opening. The particles of material returning through the opening 65 will be re-impacted by the blades 24 until they are small enough to be supported by the air blast. By adjustment of the gate 57, the velocity of the air blast in the area may be changed so as to support larger or smaller particles of material, and hence determine the size of particles which will be returned for reprocessing. It is preferable to have sight ports 68 and 69 mounted near the discharge side of the throats 46 and 47 respectively, so that the operator can visually control the size of the particles which are discharged.

After leaving the throat 57 the material enters into the separation chamber 72 which is formed as an extension on the housing 15. The chamber 72 is defined generally by an upper horizontal wall 73, side wall 74, and a vertical rear wall 75

spaced behind the vertical baffle 55. Below the throat 57 the walls of the chamber 72 extend downwardly to join a hopper-like bottom having converging front and rear walls 76 and 77 joined together by a short bottom wall 78. An opening 79 is formed in the bottom wall 78 to communicate with the interior of a large discharge pipe 80 which runs horizontally outwardly as may best be seen in Fig. 1. The pipe 80 is joined to the trough bottom 78 by a short channel section 81 and may also be supported from the bracket 19. At the outer end of the pipe 80 is a blower means (not shown) which serves to exhaust the waste rock which falls during the separation process. Intake pipe means in the form of a blower pipe 82 is spaced above the discharge pipe 80 for aiding in the separation process as will later be described.

The air blast carrying the rock particles and asbestos through the throat 57 does not enter freely into the chamber 72, but is inclined downwardly by spaced upper and lower baffles 86 and 87 respectively. The lower baffle 87 is fixed and extends from the lower edge of the throat 57 to approximately the center of the chamber 72. On the outer end of the baffle 87 is a horizontal section 88 terminated by a small upturned flange 89. As is indicated by the flow arrows of Fig. 3, the air blast is thus deflected upwardly as it leaves the baffle 87.

The upper baffle 86 is mounted for a limited pivotal movement about a horizontal hinge means 90 fastened near the upper edge of the throat 57. A crank-linkage 91 is fastened on the outer edge of the baffle 86 for moving the latter about the hinge 90. The crank-linkage 91 is supported on a horizontal shaft 92 which extends outwardly to one side of the housing 15 and engages a manual control handle 93. Angular movement of the handle 93 determines the spacing between the outer end of the upper baffle 86 and the lower baffle 87.

Another fixed baffle 94 extends downwardly from the rear housing wall 75 and terminates in the center of the enclosure 72 below the upturned lip 89 on the end of the baffle 87, forming a lower mouth 95 to which the waste rock is discharged. The air blast passing between the baffles 86 and 87, is sharply deflected by the baffle 94 and continues upwardly in the enclosure 72. At the top of the enclosure 72 a suitable flue 96 is supported on the top wall 73 for discharging the processed material. A slanted baffle 97 extends downwardly from the front wall of the housing 15 to deflect a blast into the flue 96, and a manually controlled damper 98 may be mounted in the flue to further control the blast through the apparatus. After passing out through the flue 96 the asbestos fibers are separated from the air blast by a conventional cyclone separator or other suitable means as are well known in the art.

The separation of the rock particles from the asbestos fibers is quite simple. It will be remembered, that the larger rock particles were deflected for reprocessing in passing through the throats 46 and 57. The mixture of asbestos and rock particles which is carried by the air blast between the baffles 86 and 87 contains only small rock particles, the degree of fineness being determined by the adjustment of the throats 46 and 57. Moreover, it will be understood that the proportion of the asbestos fibers in the mixture at this stage is relatively high. As can be seen in Fig. 3, the air blast makes substantially a 180°

turn after leaving the lower baffle 87. This large angular deflection causes much of the material to impinge on the baffle 94 and tend to fall downwardly through the mouth 95.

The blower pipe 82 is positioned near the mouth 95 and discharges air through a series of perforations 83 spaced along the top and bottom thereof. Air is supplied to the blower pipe 82 from a suitable outside source (not shown), and is regulated by an intake valve 84 as is seen in Fig. 1. The air jetted through the top perforation 83 opposes the tendency of the mixture to fall through the mouth 95. A turbulent condition is created, and the swirling of the material separates the asbestos fibers from the rock particles. The jets of air through the perforations 83 are adjusted by means of the valve 84 to a flow which supports the asbestos fibers, but will not support the more compact rock particles which fall downwardly and are carried out by the waste pipe 80. The lower jets 83 aid in forcing the rock into the pipe 80, and keep the passage 79 open for continuous flow.

The control of the separation process can now be more fully understood. By adjustment of the valve 84 and the baffle control handle 93, the opposed air blasts at the mouth 95 may be proportioned so as to support different diameters and lengths of asbestos fibers without supporting the rock particles. To this end it should be remembered that the size of the rock particles in the air blast will be largely determined by the adjustment of the throats 46 and 57, while the fiber structure of the asbestos is dependent upon the stratification of the raw ore.

It will be readily appreciated by those skilled in the art that a major advantage of the preferred apparatus lies in the fact that the material is handled in a continuous flow without the necessity of screening or the use of water as would tend to destroy the separability or length of the asbestos fibers.

While the particular apparatus herein shown and described in detail is fully capable of obtaining the aforementioned objects and advantages, it is to be understood that I do not wish to limit myself to the details of construction or design herein shown, except as defined in the appended claims.

I claim:

1. Apparatus for classifying and separating air-suspended particles comprising: a housing having a lower entrance opening and an upper discharge opening; means defining a plurality of passageways in said housing communicating with said entrance opening to receive a blast of air having different kinds of particles suspended therein, said passageways being formed to deflect said air blast through sharply angled turns in a generally ascending path; means forming a chute opening into the passageway spaced after the first of said angled turns for catching particles displaced from said air blast and returning said particles for recirculation; a chamber in said housing connected to the upper one of said passageways and to said discharge opening; spaced downwardly inclined baffles in said chamber deflecting said air blast into the center thereof, the upper of said baffles being pivotally mounted to adjust the degree of constriction of said air blast, and said lower baffle having an inner upturned end portion; a fixed baffle in said chamber inclined downwardly in opposition to said lower baffle and having the lower end thereof spaced below said upturned end portion of the latter to

define a mouth generally opposed to the direction of flow of said air blast; and intake pipe means spaced below said mouth and having vertically directed apertures therein to deliver upwardly directed air jets.

2. Apparatus for classifying and separating air-suspended particles comprising: a housing having a lower entrance opening and an upper discharge opening; means defining a plurality of passageways in said housing communicating with said entrance opening to receive a blast of air having different kinds of particles suspended therein, said passageways being formed to deflect said air blast through sharply angled turns in a generally ascending path; means forming a chute opening into the passageway spaced after the first of said angled turns for catching particles displaced from said air blast and returning said particles for recirculation; a chamber in said housing connected to the upper one of said passageways and to said discharge opening; spaced downwardly inclined baffles in said chamber deflecting said air blast into the center thereof, the upper of said baffles being pivotally mounted to adjust the degree of constriction of said air blast, and said lower baffle having an inner upturned end portion; a fixed baffle in said chamber inclined downwardly in opposition to said lower baffle and having the lower end thereof spaced below said upturned end portion of the latter to define a mouth generally opposed to the direction of flow of said air blast; intake pipe means spaced below said mouth and having vertically directed apertures therein to deliver upwardly directed air jets; and means connected to the bottom of said chamber below said pipe means for catching particles falling through said upwardly directed air jets.

3. Apparatus for classifying and separating air-suspended particles comprising: a housing having a lower entrance opening and an upper discharge opening; baffles secured within said housing and defining a plurality of passageways communicating with said entrance opening to receive a blast of air having different kinds of particles suspended therein, said passageways being formed to deflect said air blast through sharply angled turns in a generally ascending path; gate members cooperatively mounted with said baffles to constrict said air blast in said passageways; means forming a chute opening into the passageway spaced after the first of said angled turns for catching particles displaced from said air blast and returning said particles for recirculation; a chamber in said housing connected to the upper one of said passageways and to said discharge opening; spaced downwardly inclined baffles in said chamber deflecting said air blast into the center thereof, the upper of said baffles being pivotally mounted to adjust the degree of constriction of said air blast, and said lower baffle having an inner upturned end portion; a fixed baffle in said chamber inclined downwardly in opposition to said lower baffle and having the lower end thereof spaced below said upturned end portion of the latter to define a mouth generally opposed to the direction of flow of said air blast; and intake pipe means spaced below said mouth and having vertically directed apertures therein to deliver upwardly directed air jets.

4. Apparatus for classifying and separting air-suspended particles comprising: a housing having a lower entrance opening and an upper discharge opening; baffles secured within said housing and defining a plurality of passageways communicating with said entrance opening to receive a blast of air having different kinds of particles suspended therein, said passageways being formed to deflect said air blast through sharply angled turns in a generally ascending path; gate members cooperatively mounted with said baffles to constrict said air blast in said passageways; means forming a chute opening into the passageway spaced after the first of said angled turns for catching particles displaced from said air blast and returning said particles for recirculation; a chamber in said housing connected to the upper one of said passageways and to said discharge opening; spaced downwardly inclined baffles in said chamber deflecting said air blast into the center thereof, the upper of said baffles being pivotally mounted to adjust the degree of constriction of said air blast, and said lower baffle having an inner upturned end portion; a fixed baffle in said chamber inclined downwardly in opposition to said lower baffle and having the lower end thereof spaced below said upturned end portion of the latter to define a mouth generally opposed to the direction of flow of said air blast; intake pipe means spaced below said mouth and having vertically directed apertures therein to deliver upwardly directed air jets; and means including a hopper and a suction discharge pipe connected to the bottom of said chamber below said pipe means for catching particles falling through said upwardly directed air jets.

5. Apparatus for classifying and separating air-suspended particles comprising: a housing having a lower entrance opening and an upper discharge opening; baffles secured within said housing and defining a plurality of passageways communicating with said entrance opening to receive a blast of air having different kinds of particles suspended therein, said passageways being formed to deflect said air blast through sharply angled turns in a generally ascending path; gate members cooperatively mounted with said baffles to constrict said air blast in said passageways; external operating means connected to said gate members to adjust the opening therethrough; means forming a chute opening into the passageway spaced after the first of said angled turns for catching particles displaced from said air blast and returning said particles for recirculation; a chamber in said housing connected to the upper one of said passageways and to said discharge opening; spaced downwardly inclined baffles in said chamber deflecting said air blast into the center thereof, the upper of said baffles being pivotally mounted to adjust the degree of constriction of said air blast, and said lower baffle having an inner upturned end portion; external operating means connected to said upper baffle to adjust the degree of constriction of said air blast; a fixed baffle in said chamber inclined downwardly in opposition to said lower baffle and having the lower end thereof spaced below said upturned end portion of the latter to define a mouth generally opposed to the direction of flow of said air blast; intake pipe means spaced below said mouth and having vertically directed apertures therein to deliver upwardly directed air jets; and means including a hopper and a suction discharge pipe connected to the bottom of said chamber below said pipe means for catching particles falling through said upwardly directed air jets.

(References on following page)

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
Re. 15,275	Mettler	Jan. 24, 1922
21,945	Cox	Nov. 2, 1858
241,513	Ross	May 17, 1881
247,694	Schultz	Sept. 27, 1881
247,946	Pomeroy	Oct. 4, 1881
393,411	Willis	Nov. 27, 1888
485,571	Barnard	Nov. 1, 1892
1,074,040	Bettington	Sept. 23, 1913
1,244,788	Steckle	Oct. 30, 1917
1,310,917	McCool	July 22, 1919
1,380,322	Lindsay et al.	May 31, 1921
1,418,735	Plaisted	June 6, 1922
1,427,117	Moore et al.	Aug. 29, 1922
1,434,843	Raymond	Nov. 7, 1922
1,684,365		
1,741,869		
1,768,619		
1,934,180		
2,162,396		
2,221,385		
2,546,286		

Name	Date
Dolbear	Sept. 11, 1928
Mett	Dec. 31, 1929
Lykken	July 1, 1930
Fischer	Nov. 7, 1933
Solomon Jr.	June 13, 1939
Rogers	Nov. 12, 1940
Zakel	Mar. 27, 1951

FOREIGN PATENTS

Number	Country	Date
112,997	Switzerland	Dec. 16, 1925
533,414	Germany	Sept. 14, 1931
138,040	Austria	June 25, 1934
425,271	Great Britain	Mar. 11, 1935
614,663	Germany	June 14, 1935