May 28, 1968 C. A. MURPHY 3,385,436

PNEUMATIC CONCENTRATOR

Filed May 31, 1966 3 Sheets-Sheet 1

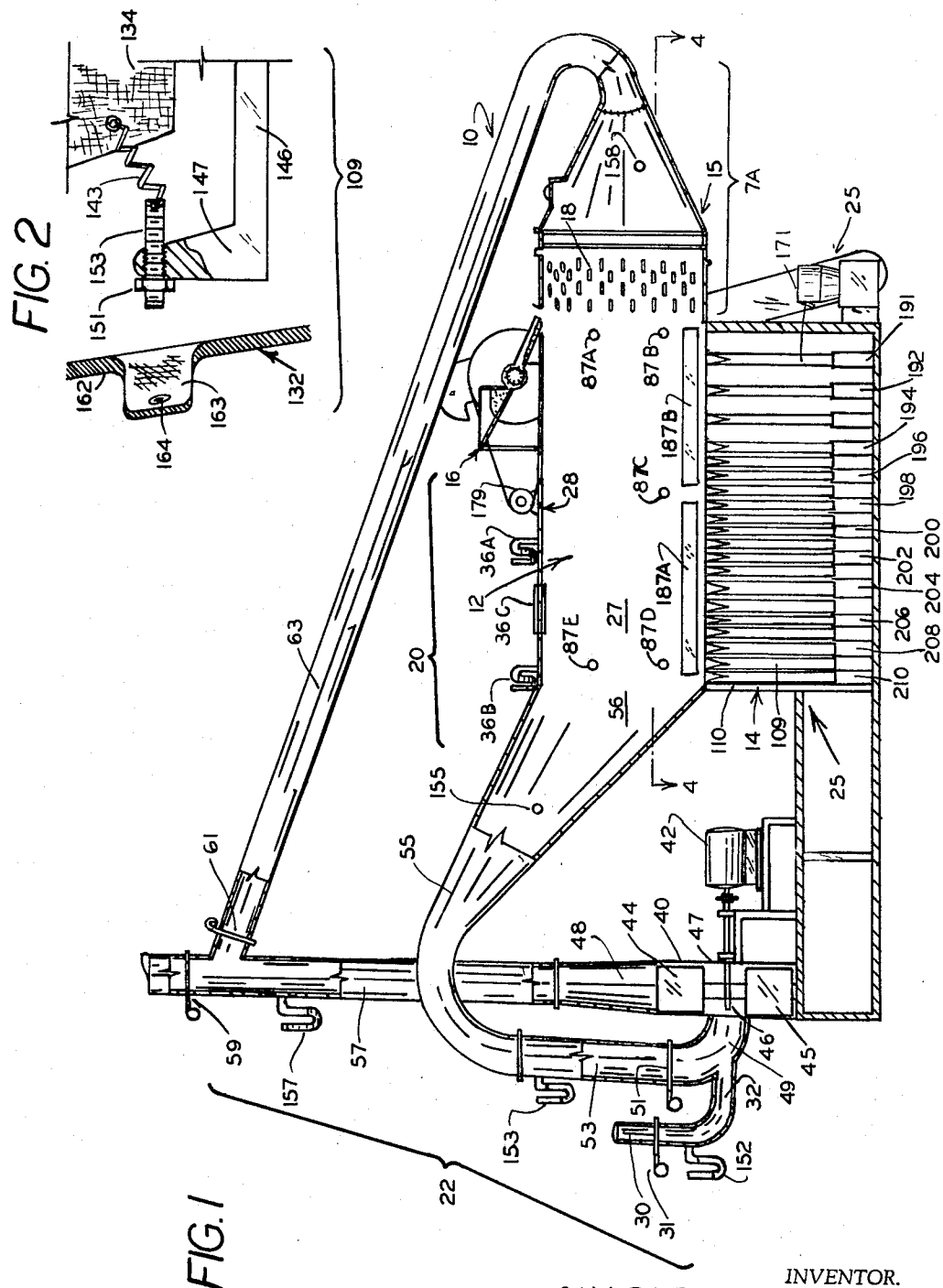


FIG. 2

FIG. 1

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May 28, 1968 C. A. MURPHY 3,385,436

PNEUMATIC CONCENTRATOR

Filed May 31, 1966 3 Sheets-Sheet 2

FIG. 3

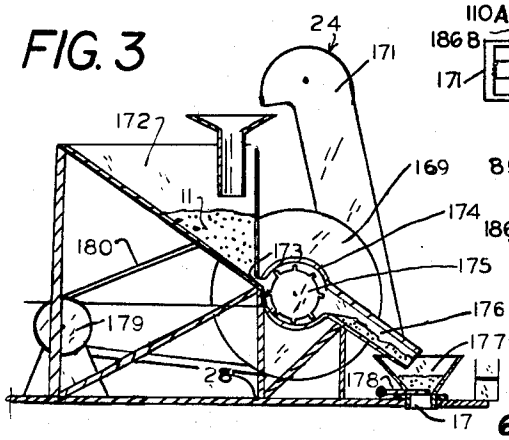
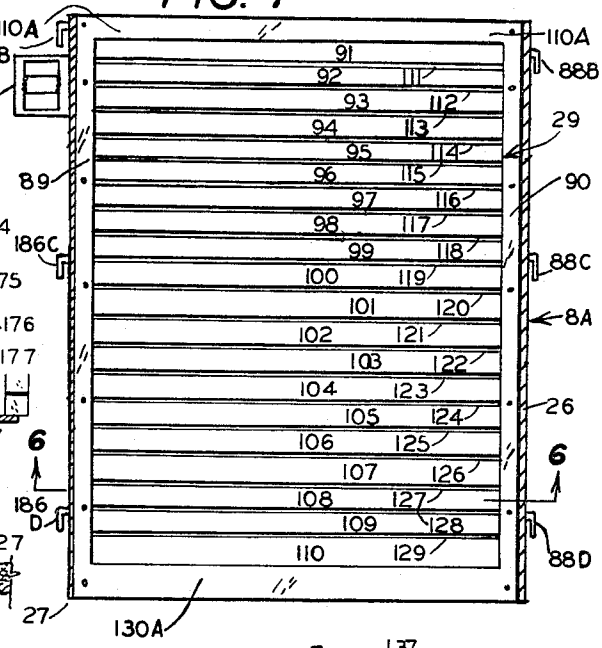


FIG. 4



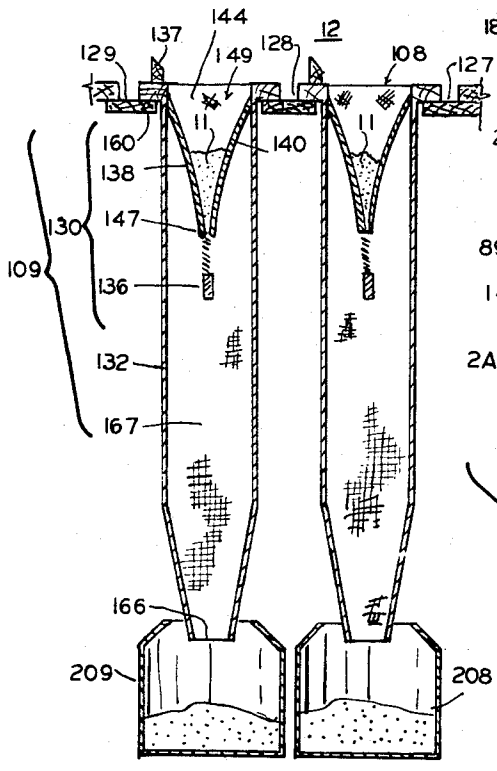


FIG. 5

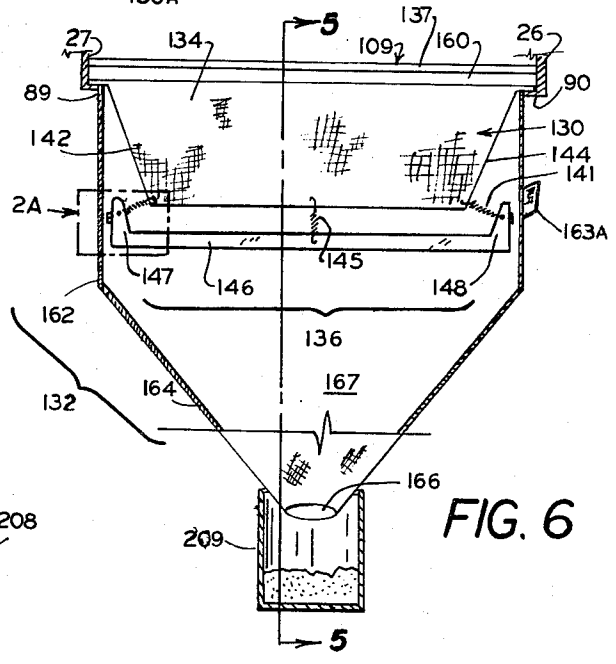


FIG. 6

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May 28, 1968 C. A. MURPHY 3,385,436

PNEUMATIC CONCENTRATOR

Filed May 31, 1966 3 Sheets-Sheet 3

FIG. 7

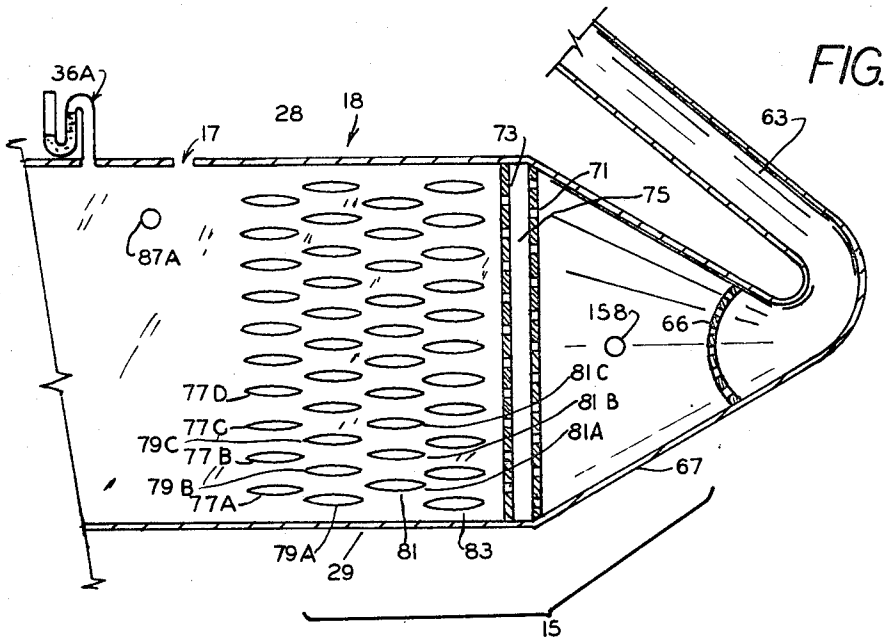
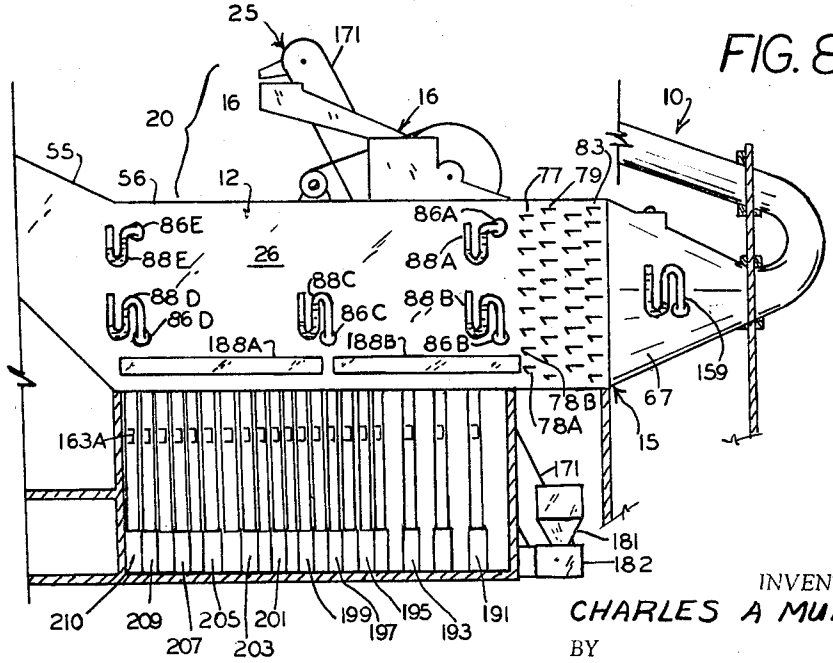


FIG. 8



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United States Patent Office 3,385,436 Patented May 28, 1968

3,385,436

PNEUMATIC CONCENTRATOR

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Filed May 31, 1966, Ser. No. 554,163
6 Claims. (Cl. 209—135)

This invention relates to an apparatus for pneumatic concentration of ores and the process of its operation. More particularly this invention is directed to a process for concentration of flaky ore material such as mica.

While the treatment of mixtures of materials of varying shapes and gravity have been the subject of delicate and involved mathematical analysis such as Gaudin, "Principles of Mineral Dressing," McGraw-Hill, New York, 1939, p. 197, in separating materials of disparate size as well as specific gravity there have been differences of opinion as to the best method of separation of the various fractions of ore by pneumatic separators, e.g., Taggart, "Handbook of Mineral Dressing," Wiley & Sons, New York, 1945, section 9, pp. 29–30 teaches that in air separators air classification is a sizing rather than a sorting operation because differences in specific gravity are not utilized yet also teaches (section 9, p. 32) that all modern commercial air classifiers use inertia and gravitational forces in combination. Further, the discontinuous character of the discharge from such machines upsets the balance therein.

Accordingly, while much work has been done to approximate species of smooth curves to characterize the operation of apparatuses for air classification of solid particles, such apparatuses have been complex to operate practically as well as to set up theoretically.

These past difficulties have been met by compromises between theoretical curves for intended operational characteristics and, thereover, approximations to compensate for irregularities in classifier discharge and the effect thereof on the operation of the classifier. In large operations, where sufficiently substantial volumes of each fraction may be obtained to form a screw conveyor seal, steady state operations are obtained, but close cuts are not made because such apparatus not only are adapted only to very large scale operations, but the number of cuts are limited by the size and cost of such screw conveyors and also the time delay to determine and correct for ore variation is so long that, in practice, only one setting is made for a given ore and variations in the operation of the apparatus are absorbed in the product.

Such apparatuses are not adjustable to small scale operations and rapid changes in ore composition as well as being expensive to construct and slow to effectively control.

This invention is directed to overcome the obstacles heretofore met by the prior art by a novel apparatus and the process of its operation.

This invention teaches an apparatus and process of operation thereof that is simple, rapid, inexpensive and reliable, notwithstanding prior involved mathematical operations, by achieving steady state operations. Herein the conditions of air velocity and rate of solid feed and of discharge are maintained constant; notwithstanding the variations in particle size of the feed the same shape and size of particles of each mineralogical species achieves the same selective sharp path and, are selectively recovered by use of a multiplicity of fine cuts. Further, the recovered fractions obtained are closely sized and uniform because also, of the incorporation in the apparatus of a novel discharge mechanism which provides no interference with the air flow and avoids the turbulence in critical regions that affect the final path of small particles. The

operation of the process is readily followed and quickly controlled.

One object of this invention, accordingly, is to provide a new and useful apparatus for the separation of particles of different sizes and shapes.

Yet another object of this invention is to provide an improved discharge apparatus for an air separation apparatus.

Yet another object of this invention is to provide an improved process of operation of an air separator.

Other objects of this invention will become apparent to those skilled in the art upon a study of the below description thereof and of the herewith provided drawings, which drawings form a part of the description of this invention and in which drawings the same reference numeral refers to the same part throughout and wherein;

FIGURE 1 is an overall diagrammatic longitudinal section view of a preferred embodiment of an apparatus, **10**, according to this invention;

FIGURE 2 is an enlarged view of zone **2A** of FIGURE 6;

FIGURE 3 is an enlarged diagrammatic view of subassembly **16** of apparatus **10**;

FIGURE 4 is a horizontal sectional view along section **4—4** of FIGURE 1; it shows the arrangement of and the tops of the orifices of the discharge valves;

FIGURE 5 is a longitudinal vertical section along plane **5—5** of FIGURE 6;

FIGURE 6 is a transverse vertical view along plane **6—6** of FIGURE 4 and shows a front view of a discharge valve subassembly **109** according to this invention;

FIGURE 7 is an enlarged view of zone **7A** of FIGURE 1; and

FIGURE 8 is a side view of the chamber **12** of apparatus **10** as seen along direction of arrow **8A** of FIGURE 4.

A preferred embodiment of apparatus **10** of this invention comprises, in operative combination, an air deflection chamber assembly **20** in series with a fan and air circulating duct subassembly **22** and a chamber discharge collection and conveyor subassembly **25**.

Chamber subassembly **20** comprises a chamber **12** and, operatively connected thereto at its bottom, a discharge valve subassembly **14**; at its top, a feeder subassembly **16**; on one, inlet, side, **15**, an inlet to an outlet of subassembly **20** and a louvre subassembly **18**; and on the other, outlet, side, **56**, an outlet to an inlet of subassembly **20**.

Chamber **12** is, generally, an enclosed horizontally extending conduit open at its inlet and outlet ends for passage of air therethrough and to a lesser degree at its top and bottom for passage of ore therethrough.

It has a vertical front wall **26**, a vertical rear wall **27**, a horizontal top wall **28** and a horizontal bottom wall **29**. Except for the feed inlet orifice **17** and openings to pressure test instruments **36A** and **36B** and a mechanically closed, optically transparent glass window **36C**, the top wall is imperforate; the vertical rear wall **27** is imperforate except for test orifices **87A**, **87B**, **87C**, **87D** and **87E** each connected to instruments as **186B–D** and the closed glass windows **187A** and **187B** for observation. The front wall is imperforate except for test orifices **86A**, **86B**, **86C**, **86D** and **86E** for test instruments attached thereto as **88A**, **88B**, **88C**, **88D** and **88E**, respectively, and transparent and closed observation windows **188A** and **188B**. These windows are imperforate and transparent. The interior surface of each of the walls **26**, **27** and **28** is smooth. The bottom wall **29** is provided with a multiplicity of orifices within which are seated the tops of the components of valve subassembly **14**.

Each vertical wall, as **26**, is provided with pressure sensing and indicating devices **86A**, **86B**, **86C**, **86D** and

86E; these are U-tubes, filled with water, to show pressure differences between the atmosphere and the portion of the chamber 12 to which connected.

On the rear wall the herein similar sensing devices 186B, 186C and 186D correspond to U-tube indicators 88B, 88C and 88D; such are located at top and bottom and inlet and outlet end center portions of each vertical wall as shown in FIGURES 1 and 8. Similar pressure sensing and indicating devices 152, 153, 155, 157 and 159 and 158 are provided at conduits 32, 53, 55, 57, 67 front and 67 rear, respectively.

The circulating duct subassembly 22 comprises an air inlet pipe 30 with an air intake damper 31 operatively connected thereto. Damper 31 is an adjustable gate valve. Air intake line 32 operatively connects the pipe 30, via gate valve 31 to a centrifugal blower fan 40 through a conduit Y 49. Fan 40 is operatively connected to and actuated by a standard electric motor 42. The fan 40 comprises a multiplicity of blades as 44 and 45 rotatably supported within a fan blade chamber 47. The inlet 46 to the fan blade chamber 47 is operatively connected to one arm of the inlet Y 49. The line 32 opens into another arm of the inlet conduit Y 49. An adjustable inlet damper gate valve 51 is provided at the top of the conduit Y 49 and is operatively connected thereto. A vacuum line 53 is serially and operatively connected at its bottom, discharge, end to the valve 51 and, thereby to another arm of the Y 49. The line 53 is operatively connected at its top, inlet, end to the discharge end 56 of the chamber 12 by a gradually and uniformly tapered chamber discharge conduit 55. The subassembly 22 also includes the connections from the discharge end of the fan 40 to the inlet end, 15, of the deflection chamber 12. This portion of the subassembly 22 comprises an upright fan discharge duct 57 which connects the outlet 48 of the fan chamber 47 to an upper exhaust damper valve 59 and inlet volume control damper 61. The inlet damper 61 is operatively connected to the deflection chamber charge conduit 63. Conduit 63 is operatively connected to the inlet portion 16 of chamber 12.

Within the chamber 12 at its inlet side, 15, is a louvre subassembly 18; the inlet conduit 63 enters at the outer end of the inlet portion 15 into a flared conduit 67. A perforated grill 66 (perforated with circular holes) separates the conduit 63 from the flared portion 67 and serves to even out the air flow through conduit 67 and thereby avoids having the air flow through the flared portion 67 flow primarily through the center thereof. The distribution is accomplished by that there are somewhat smaller holes in the center of the grill 69 and larger holes at the top and bottom and sides thereof, with the diameter of holes being smallest at the center of the grill and increasing in diameter linearly toward the periphery. A pair of rigid perforated plates 71 and 73 provide an equalizing chamber 75 therebetween to provide for an evenly distributed and relatively static pressure in the chamber 75. In the preferred embodiments, plates 71 and 73 are punched plates with the axis of each of the orifices in one plate not in a horizontal line with the axis of an orifice in the other of the two plates. Thereby the air flow through those plates is not directed in any one direction and a relatively static pressure is developed within the chamber 75 between the plates 71 and 73. The perforations in each of the plates 71 and 73 are equispaced and provide for equal distribution of orifice area through the area of both plates.

The louvre subassembly 18 includes a multiplicity of like sets of louvres as 77, 79, 81 and 83. Each of these sets is arrayed to provide, in cooperation with the others, a laminar flow of air through the interior of chamber 12. The set of louvres 77 comprises a series of identically shaped and sized louvres as 77A, 77B, 77C and 77D and the handles therefor exterior to wall 26 as 78A and 78B. Each of the louvres as 77D is straight, i.e., they each extend from one, front, side to the other, rear, side of the chamber 12. The upper and lower surfaces of each louvre member as 77A are curved and are symmetrical about the horizontal central plane for each louvre. The members of each set of louvres as 77A, 77B and 77C are arranged with their pivotal axis, which axis is also their central axis, horizontal and in a vertical plane which plane is perpendicular to the walls 26 and 27: corresponding louvre members 79A, 79B and 79C of set 79 are arrayed with their pivotal axes in a vertical plane parallel to the vertical plane in which the centers of louvres 77A, 77B and 77C are arrayed. Each of the louvres as 77A of each set as 77 are pivotally adjustable and they are all pivotally located on horizontal axes parallel to each other and in the same vertical plane. Each member as 77B of set 77 is equally off-set from its neighboring member as 77A and 77C. Each of the members 79A, 79B and 79C of the set of louvres 79 is equally vertically off-set from the center lines of members 77A, 77B and 77C. Each of the members of another vertical set of louvres, 81, is arrayed in a vertical plane parallel to plane of the center lines of the louvres as 77A, 77B and 77C, respectively, with the centers of each of the separate louvres of set 81 vertically spaced from each other and at the same height as are the nearest of the louvres in the series of louvres 77A, 77B and 77C. Another set of louvres 83 is arrayed with the center lines of the members thereof parallel to the line of louvres of set 81, but off-set therefrom in the same manner as each of the members of set 79 is off-set from the members of set 77. In the set 83 the centers of each louvre 83A, 83B and 83C is the same height over the floor of the chamber 12 as are the centers of louvres 79A, 79B and 79C. The space left between the members of each set of louvres of sets 81 and 83 is the same as the spacing between the members of set 81 and 79 and between the members of set 79 and 77. Accordingly, there is created by this apparatus a laminar flow of the air through the chamber 12 with all the laminae traveling at the same horizontal speed. The adjustability of each member, as 77A, is effected by its handle 78A (77B by its handle 78B) and corrects for any manufacturing errors and adjusts the air flow in chamber 12.

The discharge valve subassembly 14 comprises a series of about 20 like discharge valves as 91–110. Each of these valves is, as seen from above, rectangular in shape and elongated transversely to the length of the chamber 12, i.e., transverse to the length of the chamber as measured from its inlet side 15 to its outlet zone 56.

The bottom wall 29 of the chamber 28 is composed of a series of about 20 horizontal separators, as 111–129, each joined at their rear and front to a rear edge strip 89 and a front edge strip 90, respectively, and end strips 110A and 130A. Each of the outlet valves as 108 and 109 are located between and supported on two of the neighboring separator strips as 127 and 128 (for 108) and 128 and 129 (for 109) as in FIGURE 5.

Each discharge valve assembly, as 109, comprises a closure subassembly as 130, a discharge guide sleeve subassembly as 132 and a frame as 160. Each closure subassembly as 132 is supported by and attached to its frame as 160 in an air-tight manner. Frame 160 is a rigid rectangular frame which encloses the elongated rectangular orifice 149 of the valve 109 and is firmly attached to the side and end walls therefor (138, 140, 142, 144, below described).

Each of the frames as 160 has at its outlet side a rigid flat vertical imperforate ridge plate 137 that extends from wall 26 to wall 27. Its upper edge is horizontal and smooth and chisel shaped with a sharp upper edge. This projects upward to make a sharp separation between adjacent pockets and precludes passage of ore accumulated between two different pockets from passing into that pocket (as 130) within the frame which supports the ridge.

The closure subassembly 130 fits inside the discharge guide subassembly 132 therefor. Each closure subassem-

bly comprises a relatively flexible pocket **134** and a tension adjustment bar subassembly **136** attached to the bottom thereof and supported thereon. Each pocket **134** is attached to the frame therefor, as **160**, in a substantially air-tight manner. Each pocket as **134** is formed of a sloped and flexible left side wall as **138**, a sloped flexible right side wall as **140**, a sloped flexible rear wall **142** and a sloped flexible front wall **144**. The bottom edges of the side walls **138** and **140** are held close to and parallel with each other by the subassembly **136** and are of the same length. The side walls and the end walls are imperforate and air-tight in the preferred embodiment although filter cloth is adequately imperforate. The walls **144** and **142** are joined at their left and right edges to walls **138** and **140**, respectively. This joining is accomplished in a continuous and air-tight manner. Accordingly, each pocket as **134** has an upper elongated rectangular opening as **149** and a lower orifice zone **150** between the bottom portions of the flat left and right side walls. This structure has an open slit at its bottom when the apparatus is at rest but is effective as a closure against air passage into the chamber **12** during operation of the apparatus **10**. However, the close approximation of the bottom edges of walls **138** and **140** does not preclude the passage of solid material downward therepast for reasons below set out.

The tension adjustment bar subassembly **136** comprises a U-shaped bar **146**, a center tension spring **145**, a rear tension spring **143** and a front tension spring **141** operatively attached thereto. Bar **146** has a rear upstanding spring supporting arm **147** and a front upstanding spring supporting arm **148**; a threaded rear spring adjustment nut **151** is attached by threads to a spring holding threaded screw **153** which is thereby adjustably located in the arm **147**. Screw **153** is firmly attached at its front end to the rear end of tension spring **143**. A front spring adjusting nut is attached to a spring holding screw similar to **153**. This screw holds spring **141** and is held in the arm **148** and is adjustable by the nut attached thereto in the same manner as shown for **153**. The spring **141** urges the front lower edge of pocket **134** to arm **148**. Springs **141** and **143** are each attached by a grommet therefor to the front and rear ends of the pocket **134** near to the bottom thereof, and slope downwards and outwards to arms **147** and **148** at about 30° to the horizontal. Spring **145** is attached to the center of arm **146** and to the lower edge of the pocket **134** slightly above the bottom edge of the pocket. It helps keep the bottom edge of the pocket in a straight line with the help of the weight of the arm **146** and rigidity of that arm. Bar **146**, and arms **147** and **148** are smooth surfaced and flat. The bar **146** is made of metal and is rigid; ⅛ inch steel stock is adequate. Spring **145** extends vertically.

The tension in the spring resiliently keeps the bottom edges of the pocket parallel to and close to each other and thereby maintains a straight and thin lower orifice therebetween.

The upper edge of the walls of pocket **134** are attached to and supported on the interior edges of the orifice **149** in the rigid rectangular frame **160**. The frame **160** is elongated transverse to the length of the chamber **12**. The attachment of the walls of the pocket to the frame **160** is an imperforate and air-tight connection.

The discharge guide sleeve subassembly **132** is firmly attached to the bottom of frame **160** and comprises an upper rectangular generally air-tight imperforate canvas sleeve portion **162** that surrounds the pocket **134**. The guide sleeve subassembly **132** also includes a lower triangular portion **164** firmly attached to and continuous with the bottom of upper sleeve portion **162**. Portion **164** terminates at its bottom in a lower orifice **166**. The discharge guide sleeve subassembly **132** surrounds a chamber **167** into which the contents of pocket **134** may be discharged without contamination with the products of other similar products from other pockets located at different positions along the length of the bottom of chamber **12**. The bottom front and rear walls of the guide sleeve **132** at its triangular portion **164** are flexible and arranged at an angle to the horizontal greater than the angle of repose of the material to be collected, 60° in the preferred embodiment. Hence, it may be shaken and moved readily and even at rest there is no accumulation of material in that sleeve.

In the operation of the apparatus **10** the somewhat greater pressure outside of chamber **12** and within the upper portion of the guide sleeve **132** causes the walls as **138** and **140** to assume a curved shape convex toward chamber **12** as shown in FIGURE 5. This curvature is the resultant of the weight of the bar **146** and the difference in pressure between the pressure outside of chamber **12** as in chamber **167** and the pressure inside chamber **12**. The difference is due to the rate of flow of gas and solid material through the chamber **12** and the vacuum created by fan **40**. The action of this relative vacuum to form a curved surface all across the length of each of the walls as **138** and **140** is attenuated by the weight of the bar **146** and the action of its springs **141**, **143** and **145** keeping the lower orifice **150** open for the valve **109**; for all the other valves in subassembly **14** of the apparatus **10** the coaction of pocket walls, air pressure and tension bar is the same. Accordingly, in operation of apparatus **10**, as below described, the side walls as **138** and **140** of each valve as **109** are approximated to each other by the difference in pressure between that in chamber **12** and that exterior thereto as in **167**. Thereby a very gentle yet definite closure action is effected. This is a very gentle closure action and permits the accumulation of sized particulate matter in the pocket **109** and, on accumulation of a definite yet small weight thereof adequate to force open a portion of the orifice **150**, to discharge a portion of that accumulation in that pocket portion automatically along each portion along the length thereof, with some accumulation still remaining in the pocket. This action of discharging and sealing occurs at each portion of the pocket independently of the action at another portion of the pocket distant therefrom and without causing any surges of air current although there is only a very light accumulation in the pocket and only small amount of discharge at any one time. This structure thus prevents the passage of air upward through each valve as **109** notwithstanding that the valve (and other valves like it) has a substantial width (as measured transverse to the length of chamber **12**) and this action on each valve, as **109**, is substantially the same all through the width of each valve. The tension of springs as **141** and **143** and **145** keep the bottom edges of each pocket in a straight line and maintain the curvature of the pocket substantially constant throughout its width, i.e., from the rear edge to the front edge of each pocket.

Each sleeve, as **132**, has a flap as **163** lateral to and at the same vertical level as each adjustment screw and nut, as **153** and **151** for the rear valve **109**, on each end of such sleeve and the flap **163** has a snap **164** for holding the flap closed. A similar flap (**163A**) is on the front of sleeve **132** to provide for adjustment of the spring **141** and all sleeves have similar flaps to facilitate access to and adjustment of the tension across the bottom of each pocket of each valve.

The difference in pressure from chamber **12** to the outside thereof (i.e., to the chamber **167** for the valve **109**) is in the embodiment below described only about 10″ water or about ⅓ pound per square inch. There is usually only a height of about 1/20 pound of material per linear inch in the pocket **109** and yet the opening is automatic and the closure complete.

Adjustment of the tension of the springs **141** and **143** as below described provides that a greater or less accumulation provide for an automatic discharge of the additional material accumulated in the pocket through the bottom orifice of that pocket. The valves as **109** thereby

each provides for an automatic valve opening which does not create any air disturbance over the top of the valve and permits a constant set of conditions to be operative over the bottom floor of the chamber **12** although the quantitative amount of ore in each pocket be small. To collect the pocket discharge, open topped transparent containers **191–210** are provided under each of the orifices (as **166** on **109**) for each valve, as **91–110**, respectiveiy. The orifice of each discharge guide (as **166** for valve **109**) for each valve fits into and extends slightly below the open mouthed top of each such container as container **209** for valve **109**. The bottom of each guide sleeve as **132** is made of flexible cloth, hence is easily removed from the container as well as closed off (by folding) when containers are exchanged during operation of the apparatus **10**.

The chamber discharge collection and conveyor assembly **23** comprises the containers **191–209**, the mixer **181** and the conveyor **171**. The containers **191–209** are transparent glass or vinyl jars that permit visual observation of the contents and ready removal of a portion thereof for optical inspection by a low power microscope. The mixer **181** is a conventional mixer for use in starting up the process as above described. The conventional ore conveyor **171** is fed from mixer **181** and discharges to hopper **172**. **181** is hand-fed. The feeder subassembly comprises a hopper **172**, a star wheel and a distributor and chute. Hopper **172** has a bottom sloped, at a 50° angle to the horizontal, and is open at its bottom, **173**, to a star wheel chamber **174** wherein a standard star wheel **175** is driven by a motor **179**. Motor **179** is connected to a belt drive **180** to a large size star wheel drive pulley **169**. The star wheel discharges the to-be-separated ore **11** onto a distributor **176** which passes the ore via V-shaped chute **177** into orifice **17** in the top wall **28** into the chamber **12**. The ore is fed at a constant rate into the chamber **12**: the ore provides a seal in chute **177** and the atmospheric pressure urges the ore through lower chute orifice **173**. Distributor bottom **176** is corrugated transverse to the direction of ore passage thereover to equalize the amount of ore distributed to each portion of the chute **177** and orifice **17**. Orifice **17** and the bottom of chute **177** each extend the full width across chamber **12**. A slidable closure plate **178** across the bottom of chute **177** controls the flow through chute **177**, which has an open top.

In operation feed is added to the hopper **171** and chute **177** and the valve plate **178** closed and the fan **40** is set in operation by the motor **42**. This develops a negative pressure at the air inlet **30** as measured at indicator **152** and a positive pressure at the exhaust discharge valve **59** (and measured at **157**) and also at the chamber **67** as measured at **157** and **158**. Valve **59** is adjusted to discharge fines and valve **61** is adjusted to maintain a small but positive pressure at indicator **159**. The valve **51** is adjusted to provide a negative value of several inches of water at **153**. Valve **31** is adjusted to compensate for loss of air at valve **59** but the inlet volume is kept low so that the vacuum as measured at **152** is not so far below that at **153** to permit proper operation of the pockets as **134** of the valves **91–110**.

The valve **51** is adjusted to develop a negative pressure at **153** and a pressure drop across the louvre assembly **18**: this is facilitated because of the absence of louvres between the feed inlet **17** and the valve **51**. Accordingly, after the fan has been set in operation there is a slight negative pressure at the orifice **17** (measured at **88A**). Then ore is moved from hopper **172** to chute **177** by star wheel **174** and the reading on the pressure gauge **88E** is compared to the reading on **88B** to see if there is any leakage through the chute **177**. More ore is added to chute **177** until **88A** and **88B** read the same. The louvres may be adjusted to provide the pressure at **88E** and **88C** to be the same and at a slightly definite negative value. The negative pressure at **88A** and **88B** is also adjusted by the louvres and gate valves to be the same as each other although definitely a less negative value (higher absolute value) than **88E** and **88C**. These pressure readings indicate the proper flow of the air through the chamber **12**. There is thus a definite vacuum created in the chute **17** and thence evently and steadily through the orifice **17** into the chamber **12** all across its width. Feeding is continued for about 20 minutes at the end of which time the above described pressure relationships are the same as above described. That is, the pressure at **88E** and **88C** is the same and the values shown there are negative values. The pressure reading devices at **88E** and **88C** may be conventional U-tubes which are read in inches of water. They are open to the atmosphere at the top. The adjustment springs **141** and **143** may then be adjusted for a continuous rate of discharge through the bottom edges thereof while (as per observation as through window **188A**) keeping a seal of ore in each pocket. This is done by unbuttoning a flap as **163**, adjusting the adjacent spring as **141** and a similar flap as **163A** adjacent spring **141** in order to turn the adjustment nuts (as **151**) therefore. This adjustment provides for an even discharge of ore through the bottom of each pocket and a suppression of any air flow upward through the orifices as **149**.

A light is provided at window **36C** and **187A** and **187B**. This permits visual observation at windows **188A** and **188B** of the flow of gas and mineral particles through chamber **12** and permits the operator to observe the laminar flow of the material through the chamber. Some minor adjustments may be made for any or all of the louvres by the louvre handles (as **78A**, **78B** for louvres **77A** and **77B**). It is to be noted that this apparatus provides that there is substantially no pressure drop from the set of louvres closest to the interior of the chamber **12**, i.e., set **77** and the outlet **56** of the chamber **12**. Negative pressure exists throughout the entire chamber **12**. This also provides that, while there is the least negative pressure near the feed inlet **17**, this is the zone in which the heaviest ore falls to its discharge valve, as **91**. Accordingly, the adjustment on the pockets provides for the largest pocket discharge opening near to the inlet **15**. However, such size slit as is provided by the springs acting across the bottom of the pocket is adequate, as the air flow for such ore is not critical and the size of slit is adequate for its purpose especially as it is adjustable. Near the outlet etnd **56** of chamber **12**, where the ore fractions are the lightest and the most delicate of adjustments is necessary for separation of the ore fractions, the pressure differential between the interior of the chamber and the exterior thereof is the greatest and the closest and most delicately controlled seal is formed by the left and right walls, as **138** and **140** of each pocket, as **134**, as above described.

The product of the ore separator is collected in the containers **191–210** and the apparatus is then ready for its continuous operation. For this purpose the samples collected during this **20** minute period are returned to a mixer, as **181** and thence, to a mixer bin as **182**, and thence, to the feed conveyor **171** for return to the hopper **172**.

At this point the apparatus is now in a steady flow state and the discharge outlet subassemblies as **109**, **110** and **106** which may be producing fractions which are useful and valuable are collected and saved. The other fractions may be sent to waste by conveyors or simply collected in baskets.

After a sufficient volume of any one fraction (e.g., at **209**) is collected to fill the hopper **172** all the other containers as **201–7** may be emptied and the material caught on the first run of concentration be refined using the apparatus as its own cleaner, following what might be regarded as the "roughing" operation theretofore made. It is important that the fan and motor **40** be started prior to adding ore to chamber **12** so that the pockets will be closed by the vacuum sealing action above discussed.

It is to be noted that the valve action of each discharge is accomplished with no loss of the gaseous media while the solid feed is being discharged from the bottom of each pocket and its corresponding sleeve. Accordingly, there is no interference with the steady flow of the gaseous media throughout the apparatus from the inlet portion as **15** to the outlet thereof. The windows especially permit the observation of the flow pattern and the tension on each of the pockets as **134** is readily adjusted even during the operation of the apparatus depending on optical inspection (at 50× and 100×) of the product delivered to each container as **209**.

In a particular preferred embodiment of apparatus and operation thereof, the ore treated was 75% muscovite mica and 25% quartz, feldspar and iron oxide. The ore is ground to 100% through 20 mesh (U.S. standard) from 2" run of mine ore. The material discharged at valve **59** is between ½ and 1% by weight of the material fed and is all —325 mesh (U.S. standard). The dimensions of the apparatus **10** are as in Table I.

TABLE I

Apparatus 10 dimensions

Chamber **12**	
Interior width (**26–27**)	3'6"
Interior height (**28–29**)	3'0"
Total length (**66–130A**)	9'8"
Open chamber length (**130–77**)	6'0"
Valves, number of valves as **109**	23
Closure **134**, height (bottom edge-top edge)	5"
Width orifice **149** (**26–27** direction)	35¼"
Length orifice **149** (**91–129** direction)	2"
Length orifice **147**	30"
Wall material, sailcloth canvas.	
Sleeve **132** material, canvas.	
Portion **162** height	7"
Portion **164** height	20"
Tension bar **136**:	
Length	34¾"
Weight	2#
Thickness	⅛"
Height arm **147**	4"
Tension in spring **141** lbs.	2–10
Ridge **139**, height	1"
Louvre **77**:	
Length	3"
Thickness (vertical)	½"
Spacing between rows **77** and **79** center line	3"
Spacing between top of louvres **77A** and the bottom of **77B**	½"
Chamber **18**, length	12"
Plates **71** and **73**, ¾" diameter holes in 1¼" ½" thick plywood.	

There are 23 pockets as **109** in the apparatus (20 were used in the above discussion for purpose of simplicity of description of related parts e.g. **91–110**, **111–129**, **191–210**). Each of the ore fractions thus obtained varied less than ±10% in diameter: there was, by optical inspection, less than 1% of overlap between adjacent sized fractions of mica obtained, hence each pocket produced a fraction substantially all within one standard United States mesh size, e.g., 98% —35 mesh, 98% +40 mesh.

Although in accordance with the provision of the patent statutes, a particular preferred embodiment of this invention has been described and the principles of the invention have been described in the best mode in which it is now contemplated applying such principles, it will be understood that the operations, constructions and compositions shown and described are merely illustrative and that my invention is not limited thereto and, accordingly, alterations and modifications which readily suggest themselves to persons skilled in the art without departing from the true spirit of the disclosure hereinabove are intended to be included in the scope of the annexed claims.

I claim:

1. In a pneumatic ore separator, operatively connected, a settling chamber, a fan, a conduit, a feeder for said chamber, said settling chamber having a top wall, a rear wall, a front wall, an inlet zone and an outlet zone, the inlet of said fan being operatively connected to the outlet zone of said settling chamber, said feeder being attached to and discharging through the roof of the chamber near its inlet zone, and discharge outlets elongated transverse to the direction from the inlet of said settling chamber to the outlet of said settling chamber, said discharge outlets being located consecutively along the floor of said chamber,

each of said discharge outlets comprising flexible pocket means, sleeve means, and a frame support, said frame support being a hollow rectangle surrounding an elongated rectangular orifice, said pocket being attached to said frame, said sleeve being attached to said frame, said frame being attached to and supported on the floor of said chamber, each said pocket comprising a left wall, a right wall, a front wall and a rear wall, said front wall and rear wall each being generally V-shaped, said left and right walls having a top and bottom edge, each bottom and top edge on each wall being generally parallel to each other, said walls all being flexible and imperforate, a rigid spring supporting means below said pocket, a front tension spring extending between the bottom of the front end of said pocket and the front end of said support, a rear tension spring extending from the bottom of the rear end of said pocket to the rear end of said bar, the front end of said bar extending frontwards of the front end of the bottom of the pocket, the rear end of said bar extending rearwards of the rear end of the bottom of said pocket.

2. Apparatus as in claim **1** comprising also pressure measuring and indicating means on the walls of said chamber and ducts to operatively connect the interior of said chamber and said means; a Y with one arm thereof connected to said fan outlet, another arm of the Y connected to the atmosphere, a valve in said another arm of the Y, said inlet of said chamber connected to the third arm of the Y, and a valve in said third arm, a second Y connected to the inlet to said fan, a valved conduit connected at one end to one arm of that second Y and at another end to the atmosphere; another arm of that second Y connected to the outlet of said settling chamber through a valve.

3. Apparatus as in claim **2** comprising also a plurality of louvres in the inlet portion of the chamber, all on the inlet side of the inlet of the feeder into said chamber and no louvres between said feeder inlet and the chamber.

4. Apparatus as in claim **3** comprising also a sleeve surrounding the pocket and being attached to said frame, said sleeve having a lower portion which has an orifice at the bottom and which lower portion has side walls which are sloped and terminate adjacent said orifice, a separate receiver below each said orifice.

5. In a pneumatic ore separator a discharge outlet comprising flexible pocket means and a frame support, said pocket being attached to said frame, said frame being a hollow rectangle outlining an elongated rectangular orifice, said pocket comprising a left wall, a right wall, a front wall and a rear wall, said walls being flexible and imperforate, said front wall and rear wall being generally V-shaped, said left and right wall each having a top and bottom edge, said edges of each wall being generally parallel to each other, a rigid spring supporting means below said pocket, a front tension spring extending between the bottom of the front end of said pocket and the front end of said support, a rear spring extending from

the bottom of the rear end of said pocket to the rear end of said bar, the front end of said bar extending frontwards of the bottom of the front end of the pocket, the rear end of said bar extending rearwards of the bottom of the rear end of said pocket, adjustment means between each said spring and said support bar.

6. Apparatus as in claim 5 comprising also an air-tight flexible sleeve surrounding the pocket and being attached to said frame, said sleeve having a lower portion which has an orifice at the bottom and which lower portion has side walls which are sloped and terminate adjacent said orifice.

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