May 12, 1953 G. NIEMITZ 2,638,217

PULVERULENT MATERIAL CLASSIFYING MEANS

Filed June 22, 1950 3 Sheets-Sheet 1

Fig. 2.

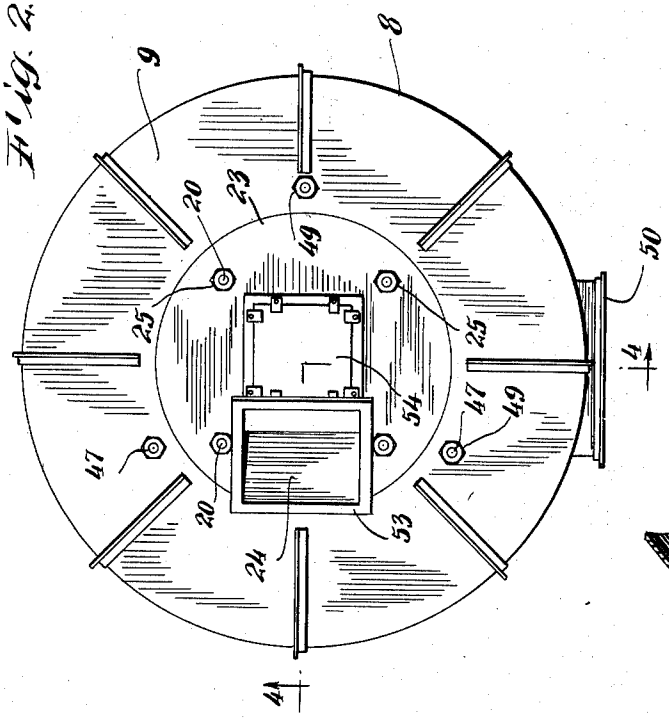


Fig. 3

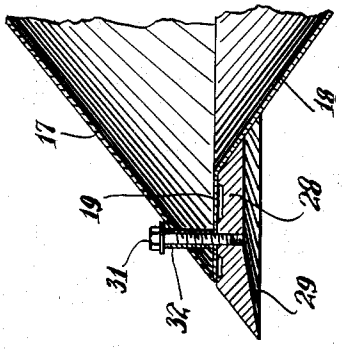
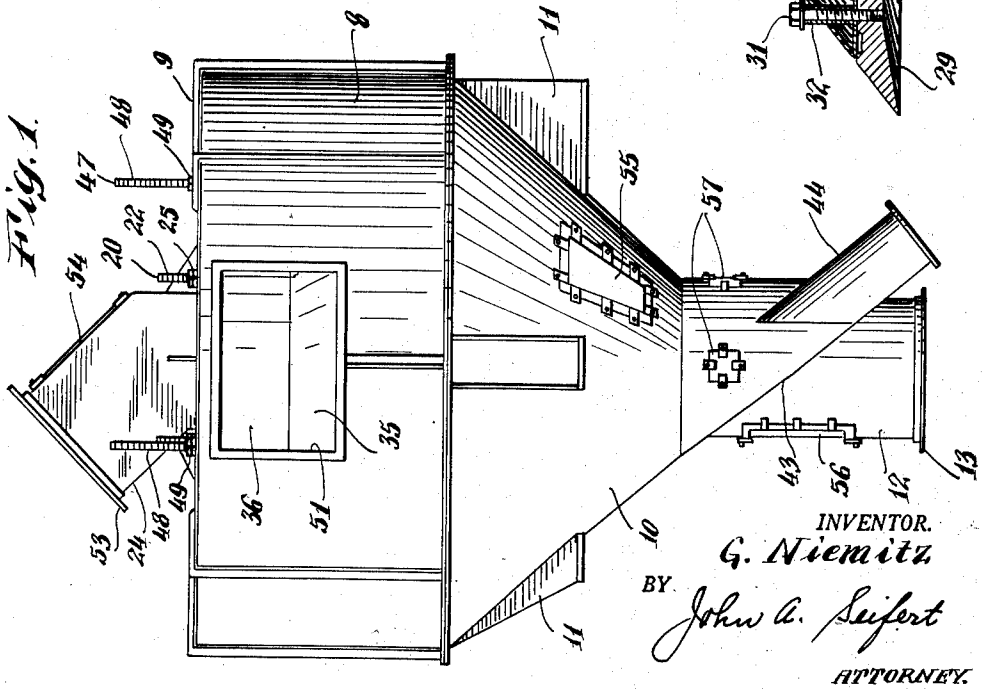


Fig. 1.

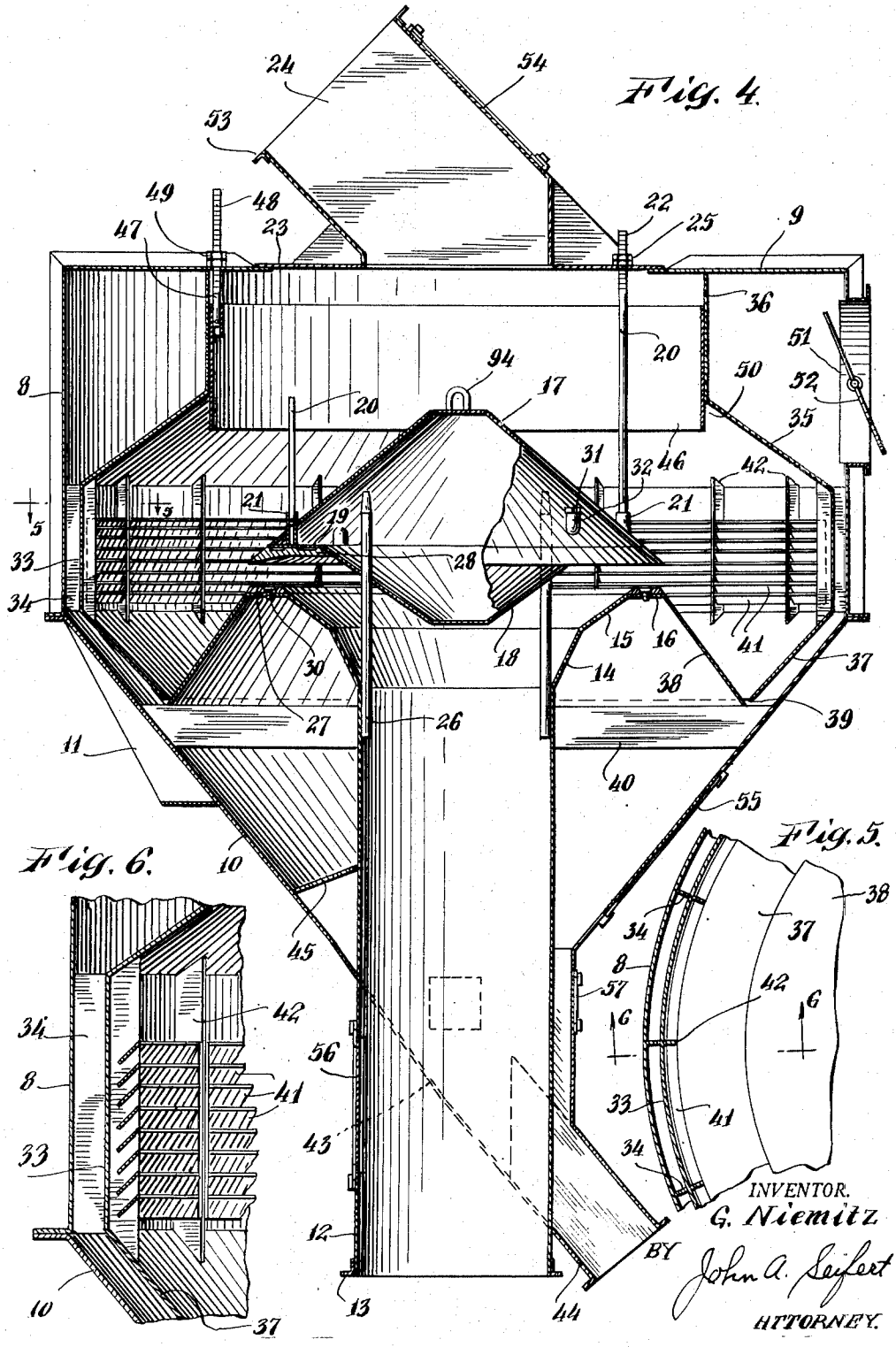


INVENTOR.
G. Niemitz
BY
John A. Seifert
ATTORNEY.

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PULVERULENT MATERIAL CLASSIFYING MEANS

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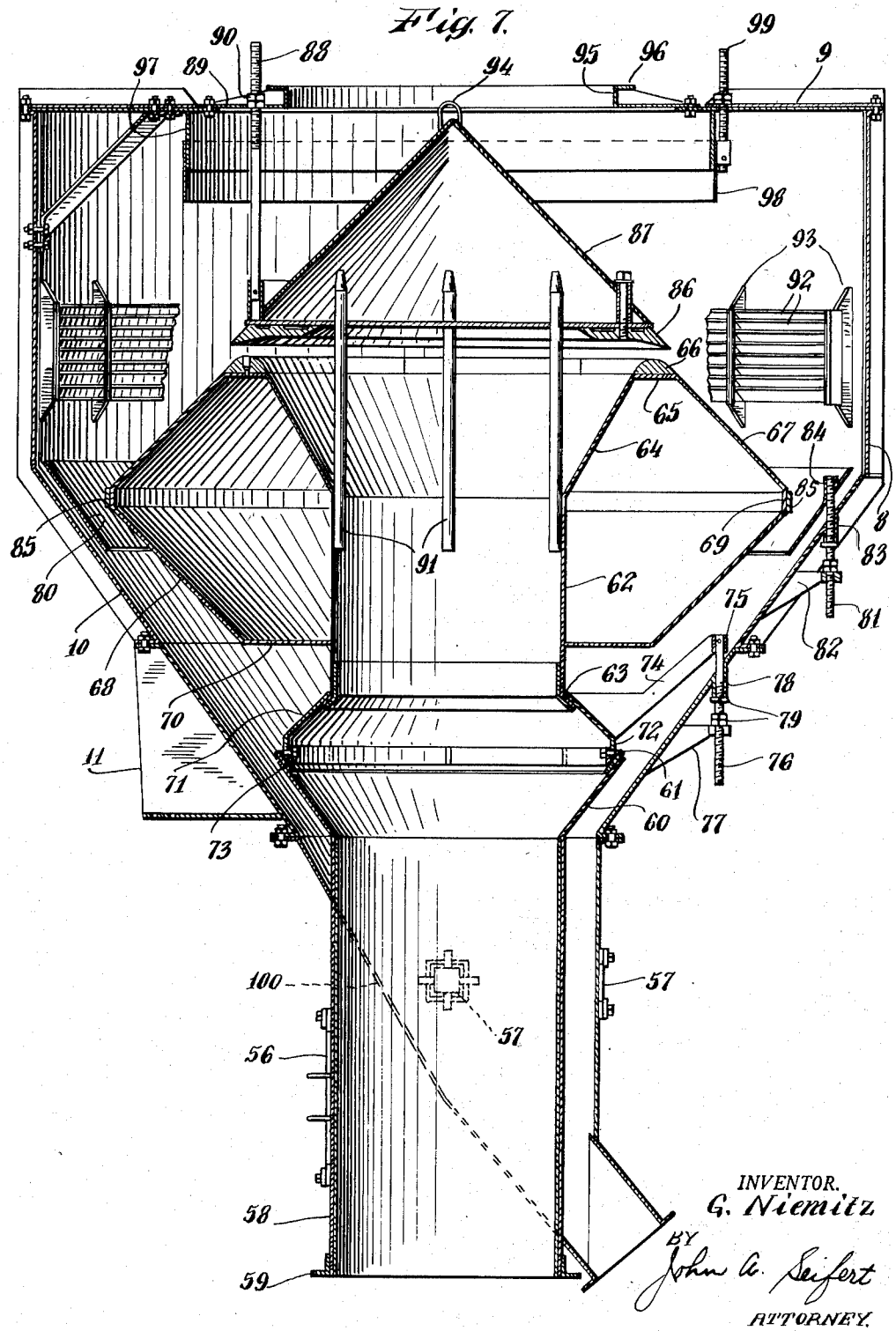


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PULVERULENT MATERIAL CLASSIFYING MEANS

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Fig. 7.



INVENTOR.
G. Niemitz
BY
John A. Seifert
ATTORNEY.

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PULVERULENT MATERIAL CLASSIFYING MEANS

Gerhard Niemitz, Bronx, N. Y., assignor to Kennedy-Van Saun Mfg. & Eng. Corporation, New York, N. Y., a corporation of Delaware

Application June 22, 1950, Serial No. 169,640

5 Claims. (Cl. 209—139)

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This invention relates to the classifying or separation of pulverulent material discharged in an air stream from pulverizing apparatus, such as a tube mill, whereby the pulverulent material of desired quality or fineness is delivered to a place of use or storage and the residue of coarse particles of the material is returned to the pulverizing apparatus for further pulverization.

It is an object of the invention to provide a classifier of this type which is readily adjustable to obtain the desired quality of pulverulent material.

Another object of the invention is to vary the velocity of air-borne pulverulent material entering a separating chamber of the classifier to provide one means of adjustment to obtain the desired quality of pulverulent material.

Another object of the invention is to interpose an adjustable baffle or gate in the path of flow of the classified pulverulent material from the separating chamber to an outlet in the classifier to provide another means of adjustment to obtain the desired quality of pulverulent material.

Another object of the invention is to introduce a controlled quantity of auxiliary fluid pressure or air stream to the residue discharge side of the separating chamber to return separated coarse particles of material to the classified pulverulent material to provide further means for obtaining the desired quality of pulverulent material.

A further object of the invention is to provide the classifier with a separating chamber comprising a housing having at the bottom an inlet for the air-borne pulverulent material and an annular hopper encircling said inlet for the discharge of the residue of coarse particles of material, a vertical series of spaced baffles spaced from the side wall of the housing and in horizontal alignment with the inlet, and an outlet at the top for the discharge of classified pulverulent material.

A further object of the invention is to provide a modified structure wherein reclassifying air is supplied to the classifier from the inlet for the air-borne pulverulent material and the quantity and velocity of the flow of said reclassifying air is regulated.

Other objects and advantages of the invention will be described hereinafter.

In the drawings accompanying and forming a part of this application,

Figure 1 is an elevational view of the classifier forming the embodiment of the invention.

Figure 2 is a top view of the classifier.

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Figure 3 is a fragmentary sectional view, on an enlarged scale, of a member adjustable toward and away from the pulverulent material inlet of the classifier to vary the velocity of discharge of said material into the separating chamber.

Figure 4 is an elevational sectional view, on an enlarged scale, taken substantially on the line 4—4 of Figure 2 looking in the direction of the arrows.

Figure 5 is a fragmentary sectional view, on an enlarged scale, taken on the line 5—5 of Figure 4 looking in the direction of the arrows.

Figure 6 is a sectional view taken on the line 6—6 of Figure 5 looking in the direction of the arrows.

Figure 7 is a view similar to Figure 4 showing a modified structure and arrangement of parts of the classifier wherein reclassifying air is supplied to the classifier from the inlet for the air-borne pulverulent material and the quantity and velocity of the flow of said reclassifying air is regulated.

The embodiment of the invention illustrated in Figures 1 to 6, inclusive, of the accompanying drawings comprises a casing having at one end a cylindrical portion 8 partially closed at one end by an annular wall 9 and a conical shaped portion 10 at the opposite end of the casing. The casing is supported in vertical position with the cylindrical portion 8 uppermost and the conical portion 10 lowermost by four leg portions 11 extended laterally from the conical portion 10 for mounting on a suitable support, not shown.

The casing is connected in communication with the discharge of a pulverizing apparatus, not shown, to receive pulverulent material suspended in an air stream. This is accomplished by an inlet conduit 12 extending through the apex of the conical portion 10 with the lower end of the conduit exterior of the conical portion and arranged with a flange 13 for connection with one end of a conveying conduit, not shown, connected at the opposite end to the discharge of the pulverizing apparatus. The opposite end of the inlet conduit 12 terminates in the cylindrical casing portion 8 and is arranged with a flaring portion including a section 14 extending outwardly from the side wall of the conduit at an obtuse angle, a section 15 extending outwardly from the section 14 at an obtuse angle, and a section 16 extending outwardly from the section 15 in a horizontal plane, as shown in Figure 4.

The air-borne pulverulent material is discharged from the flaring end portion 14—16 of the inlet conduit 12 in a horizontal plane over

the horizontal section 16 at an increased velocity. This is accomplished by a mushroom shaped member having a truncated conical shaped top 17 and truncated conical shaped bottom 18 arranged with an annular horizontal portion 19 of greater width than the horizontal section 16. The mushroom member is adjustably mounted to have vertical adjustment toward and away from the flaring discharge end 14—16 of the conduit 12 by rods 20 fixed at the lower ends in sockets 21 secured to the horizontal bottom portion 19 and extended through the top conical portion 17. The upper ends of the rods 20 are arranged with a series of notches 22 and extended through a circular plate 23 having an obliquely extending outlet 24 for the discharge of the classified pulverulent material and secured to the inner peripheral portion of the annular end wall 9, as shown in Figure 4. The upper ends of the rods 20 are adjustably suspended from the plate 23 by nuts 25 engaged with the notches 22 to abut the plate 23. The flaring sections 14, 15, 16 of the conduit 12 and the conical bottom 18 and horizontal portion 19 of the mushroom member form an annular flaring passage tapering outwardly to a horizontal discharge portion. Adjustment of the mushroom member 17—19 toward the discharge end 14—16 of the conduit 12 will narrow said annular passage and increase the velocity of the air-borne material being discharged from the conduit 12 in an annular stream. The mushroom member 17—19 is guided in its vertical adjustment by guide rods 26 secured at the lower end portions to the straight wall portion of the inlet conduit 12 and the upper portions extended through the conical bottom 18, as shown in Figure 4. To prevent undue wear of the horizontal section 16 and horizontal portion 19 by the air-borne pulverulent material, the horizontal section 16 is covered by a wear-resisting surface 27 and the horizontal portion 19 is covered by a wear-resisting surface of annular shape having a horizontal surface 28 at the inner peripheral portion and an outwardly declining surface 29 at the outer peripheral portion. The outwardly declining surface 29 cooperates with the wear-resisting surface 27 to form an outwardly restricted passage. The wear-resisting surface 27 is secured to the horizontal section 16 by screws 30 and the wear-resisting surface 28, 29 is secured to the horizontal portion 19 by bolts 31 screw threaded in said surface and supported in sockets 32 secured to the horizontal portion 19 and extended through the top conical portion 17 of the mushroom member, as shown in Figures 3 and 4.

The air-borne pulverulent material is discharged from the inlet conduit 12 into a separating chamber formed in the casing 8—10 by a housing including a vertical side wall 33 spaced from and supported by the lower section of the cylindrical casing portion 8 by ribs 34. The upper portion of the housing is arranged with a wall portion 35 inwardly inclining from the upper edge of the side wall 33 to a second vertical wall portion 36 secured to the annular top casing wall 9 in encircling relation to the inlet end of the discharge outlet 24 and forming an outlet for the classified pulverulent material from the housing, as shown in Figure 4. The lower portion of the housing is arranged with an annular hopper bottom formed by a wall 37 inwardly declining from the lower edge of the side wall 33 and a wall portion 38 outwardly declining from and supported by the horizontal section 16 of the conduit 12 and having the lower edge extending beyond and spaced from the lower edge of the wall portion 37 to form an annular outlet 39 for the discharge of the residue of coarse particles of the classified pulverulent material. The lower edge of the hopper bottom wall 38 and the inlet conduit 12 are supported from the conical casing portion 10 by spaced arms 40, as shown in Figure 4.

Within the separating chamber formed by the housing 33—39, baffles are provided for separating the coarse particles from the air-borne pulverulent material and directing the classified pulverulent material toward the outlet 24 and the coarse particles toward the hopper bottom outlet 39. These baffles comprise a vertical series of equidistantly spaced annular slats 41 supported by vertical ribs 42 secured to the inner faces of the housing wall portions 33, 35, 37 with the slats declining toward and spaced from the housing side wall 33, as shown in Figures 4 to 6, inclusive. The air-borne classified material will flow along the housing wall portions 33 and 35 to the outlet 24. The residue coarse particles will be thrown out by kinetic energy of the air stream flowing through the annular space between the surfaces 27—29 and deflected by the baffle slats 41 into the hopper bottom 37, 38 and through the outlet 39 into the conical casing portion 10. The residue of coarse particles in the conical casing portion 10 is returned to the pulverizing apparatus to be again subjected to the pulverizing action through an outlet in the apex of said conical casing portion in the form of a chute 43 declining diagonally of the exterior of the inlet conduit 12 substantially in the plane of inclination of the wall of the casing portion 10 and having an exterior tubular portion 44 arranged for connection with a return conduit, not shown, leading to the pulverizing apparatus. To facilitate the flow of the coarse particles down the chute 43, the casing portion 10 is provided with a diverging piece 45, as shown in Figure 4, to prevent accumulation of the residue of coarse material around the inlet conduit 12.

The degree of separation of the coarse particles from the air-borne pulverulent material is primarily controlled by the adjustment of the mushroom member 17—19, but is also controlled by two other means. One of said means comprises a baffle in the form of a sleeve or an annular gate 46 slidable within the housing wall portion 36 and adjustably supported by rods 47 secured at the lower end portion to said sleeve 46 and the opposite end portions extended through the annular top wall 9 and arranged with a series of notches 48 for the engagement of nuts 49 abutting the outer surface of said annular wall 9. The baffle sleeve 46 is adjusted to position the lower portion thereof below the housing wall portion 36 in angular relation to the housing wall portion 35 and form an angular pocket with said wall portion 35, as shown at 50 in Figure 4, to catch any coarse particles being carried by the air-borne pulverulent material toward the outlet 24 and cause said particles to drop to the hopper bottom 37—39. The area of the lower portion of the baffle sleeve 46 extending below the housing wall portion 36 will determine the amount of coarse particles removed from the air-borne pulverulent material.

The other means for controlling the degree of separation of the coarse particles from the air-borne pulverulent material comprises introducing an auxiliary or reclassifying fluid pressure

in the form of an air stream into the cylindrical casing portion 8 through an inlet 51 and said air stream flowing downwardly into the conical casing portion 10 and thence upwardly into the housing 33—39 through the hopper outlet 39. The upward flow of the auxiliary air stream in the housing will lift a certain amount of fine and coarse particles into the main air stream of the classified pulverulent material flowing through the outlet 24. The flow of the auxiliary or reclassifying air stream through the inlet 51 is controlled by suitable valve mechanism shown in a general way at 52 in Figure 4. The amount of auxiliary air introduced into the casing will determine the quantity of coarse particles in the air-borne pulverulent material being discharged through the outlet 24. The auxiliary or reclassifying air is completely shut-off from the casing when a maximum fineness of pulverulent material is desired.

The outlet 24 is arranged with a flange 53 for connection with a conduit, not shown, leading to a place of use or storage of the classified pulverulent material.

54, 55 and 56 indicate inspection covers in the outlet 24, conical casing portion 10 and inlet conduit 12, respectively, and 57 indicates poke holes.

Figure 7 shows a modified structure and arrangement of parts of the classifier wherein the separating chamber housing 33—39 and the auxiliary or reclassifying air inlet 51 are omitted. The structure of the classifier casing is the same as the casing shown in Figures 1 to 6, inclusive, and is indicated by the same reference numerals 8 to 11, inclusive. The inlet conduit for the air-borne pulverulent material in the Figure 7 disclosure comprises a straight end section 58 having a flange 59 at the lower end for connection with one end of the conveying conduit connected at the opposite end to the discharge of the pulverizing apparatus. The opposite end of the inlet conduit section 58 is extended into the conical casing portion 10 and is arranged with a flaring portion 60 having a ring 61 of wear-resisting material on the inner surface at the end thereof. The lower end of the opposite end section 62 of the inlet conduit is arranged with a flaring end portion having an inner wear-resisting surface and spaced from the flaring portion 60, as shown at 63. The upper end of the inlet conduit section 62 is provided with a flaring portion 64 having a horizontal flange 65. The horizontal flange 65 is arranged with a wear-resisting surface 66 secured thereto. A shell having converging wall portions 67 and 68 connected together by a vertical portion 69 is connected to the inlet conduit section 62 by wall portion 67 being united to the horizontal flange 65 and the wall portion 68 having a horizontal wall section 70 united to the section 62. The wall portion 68 and the conical casing portion 10 form an annular passage for reclassifying air discharged from the space between the inlet conduit sections 58 and 62.

The quantity of said reclassifying air is regulated by a valve in the form of a collar having a conical wall portion 71 extending in the angle of inclination of the flaring end portion 63 and a vertical portion 72 arranged with a wear-resisting ring 73 adapted to form with the wear-resisting ring 61 an adjustable annular discharge opening for the reclassifying air. The collar 71—73 is adjustably supported in the conical casing portion 10 by an arm 74 secured at one end to the wall portion 71 and having a sleeve 75 at the opposite end secured on one end of an

adjusting screw 76. The adjusting screw 76 is adjustably supported by a bracket 77 secured to the exterior of the conical casing portion 10 and the screw 76 is extended through a boss 78 in the conical casing portion 10. The screw 76 is retained in adjusted position by lock nuts 79. Adjustment of the screw 76 in an upward direction moves the collar valve 71—73 from the wear-resisting ring 61 and permit a greater amount of air to be discharged from the inlet conduit section 58 into the annular passage formed by the conical casing portion 10 and shell wall portion 68. Adjustment of the screw 76 in a downward direction moves the collar valve 71—73 toward the wear-resisting ring and decreases the quantity of air flowing from the inlet conduit section 58 into the annular passage formed by the conical casing portion 10 and shell wall portion 68. The velocity of the flow of reclassifying air through the annular passage formed by the conical casing portion 10 and shell wall portion 68 is regulated by another collar valve 80 of conical shape having an angle of inclination corresponding to the inclination of the conical casing portion 10. The collar valve 80 is adjustably mounted in the outlet portion of said annular passage by an adjusting screw 81 adjustably supported by a bracket 82 secured to the exterior of the conical casing portion 10. The adjusting screw 81 is extended through a boss 83 in the conical casing portion 10 and secured at the inner end in a boss 84 arranged in the collar valve 80. Adjustment of the screw 81 in an upward direction moves the collar valve 80 toward the shell 67—70 and increases the velocity of the flow of reclassifying air through said outlet portion of the annular passage formed by the conical casing portion 10 and shell wall portion 68. Adjustment of the screw 81 in a downward direction moves the collar valve 80 from the shell 67—70 and decreases the velocity of the flow of reclassifying air through said outlet portion. The vertical wall portion 69 of the shell is protected from abrasive action of the reclassifying air by a wear-resisting band 85 secured to the exterior surface of said wall portion 69. The small area of the discharge opening formed by the wear-resisting rings 61 and 73 will permit only passage of fine particles of pulverulent material with the air being discharged therethrough, so that the principal element flowing through the annular passage formed by the conical casing portion 10 and shell wall portion 68 is air.

The bulk of the air-borne pulverulent material in the inlet conduit 58—65 is discharged therefrom through an adjustable annular opening formed between the wear-resisting surface 66 and a wear-resisting ring 86 secured to the peripheral portion of the bottom wall of a mushroom shaped member 87. The mushroom member 87 is adjustably mounted in the casing 8—10 to vary the size of the opening by rods 88 secured at one end to the member 87 and adjustably suspended from an annular plate 89 by nuts 90 engaged on the rods and abutting said plate 89. The plate 89 is secured to the inner peripheral portion of the annular end wall 9 of the casing. The wear-resisting ring 86 and rods 88 are similar in structure and attachment to the wear-resisting surface 28, 29 and rods 20 described hereinbefore. The mushroom member 87 is guided in a vertical direction by rods 91 secured to the inlet conduit section 62 and extended through the bottom of the member 87.

Adjustment of the member 87 toward and away from the flaring end portion 64 of the inlet conduit respectively increases and decreases the velocity of the flow of air-borne pulverulent material from the inlet conduit toward a vertical series of equidistantly spaced annular baffle slats 92 mounted in spaced relation to the cylindrical casing portion 8 by vertical ribs 93. The baffle slats 92 function in the same manner as the baffle slats 41. The reclassifying air flowing from the annular passage formed by the conical casing portion 10 and shell wall portion 68 will flow along the shell wall portion 67 and act on the air-borne pulverulent material flowing from the opening formed by the wear-resisting rings 66, 86 in the same manner as the auxiliary air introduced into the casing through inlet 51 of the Figure 4 structure.

The mushroom members 17—19 and 87 are adapted to be lifted from the casing 8—10 by suitable lift mechanism attached to an eye 94 secured to said members.

The classified pulverulent material in the Figure 7 structure flows from the baffle 92 to a discharge outlet 95 in the plate 89 arranged with a flange 96 for connection with a discharge conduit, not shown, leading to a place of use or storage of the classified pulverulent material. The discharge outlet 95 is arranged with an adjustable baffle to control the coarseness of the pulverulent material being discharged therethrough. Said adjustable baffle comprises an annular wall 97 secured to and depending from the casing wall 9 and a sleeve or annular gate 98 slidable on the wall 97 and adjustably supported by rods 99 secured at one end to the gate 98 and adjustably mounted in the annular wall 9 in the same manner as rods 47. The adjustment of the gate 98 will obtain the same results obtained by the adjustment of the gate 46.

In the Figure 7 structure, the residue of coarse particles separated by the baffle 92 drop along the wall of the casing 8—10 between the valve 80 and the conical casing portion 10 onto a chute 100 similar in structure to the chute 43 of the Figure 4 structure for the return of said residue to the pulverizing apparatus as hereinbefore described.

In the Figure 7 structure, the separating chamber is formed in the cylindrical casing portion 8 by the wall of said casing portion forming one side of the chamber and the other side of the chamber being formed by the shell wall 67 and the conical side of the mushroom member 87. The bottom of said separating chamber is defined by the collar valve 80 and the top of the chamber is formed by the annular casing wall 9 and the baffle members 97, 98.

Having thus described my invention, I claim:

1. In pulverulent material classifying means, a vertically disposed casing, an inlet conduit for air-borne pulverulent material extended through the bottom of the casing and terminating at an intermediate portion of the casing, a member adjustably mounted in the casing to have adjustment toward and away from the terminating end of the inlet conduit and arranged to form with said terminating end an annular discharge opening extending in a horizontal plane, the adjustment of said member varying the width of said opening and the fineness of the material discharged from the casing, a vertical series of annular slats spaced from each other and mounted within the casing in spaced horizontal alignment with said annular discharge opening, an outlet in the bottom of the casing for the residue of coarse particles, a housing in the casing enclosing the adjustable member and spaced from the side wall of the casing, the annular discharge opening and slats within the casing and having a center opening in the upper portion communicating with the outlet in the top of the casing and an annular opening in the lower portion communicating with the bottom of the casing, and a valve controlled auxiliary fluid pressure inlet in the side wall of the casing in communication with the space between the housing and casing to control the quantity of coarse particles of material discharged through the outlet in the top of the casing.

2. In pulverulent material classifying means, a vertically disposed casing having a cylindrical upper portion arranged with an outlet for classified pulverulent material and a conical lower portion arranged with an outlet for residue of coarse particles, an inlet conduit for air-borne pulverulent material extending through and supported by the conical casing portion and terminating within the cylindrical casing portion, a housing having an annular hopper bottom arranged with a discharge opening in the apex thereof and the inner side wall of said hopper bottom secured to the terminating end of the inlet conduit and the outer side wall of the hopper bottom spaced from the wall of the conical casing portion, a vertical side wall extending upwardly from the outer side wall of the hopper bottom in spaced relation to and supported by the side wall of the cylindrical casing portion and a wall portion inclining inwardly from the vertical side wall to a second vertical wall portion secured to the end wall of the cylindrical casing portion and forming an open top to the housing communicating with the outlet for the classified pulverulent material, baffles mounted on the inner face of the first side wall of the housing in spaced relation thereto, and a member adjustably suspended from the end wall of the cylindrical casing portion for adjustment toward and away from the terminating end of the inlet conduit to form therewith an annular opening for the discharge of the air-borne pulverulent material at a high velocity in a horizontal plane into impact with the baffles, whereby the coarse particles of material are separated from the air-borne pulverulent material and the air-borne material directed by the baffles and the inclining wall portion of the housing to flow toward the outlet in the cylindrical casing portion and the coarse particles of material directed by the baffles to gravitate to the hopper bottom and through the discharge opening therein to the conical casing portion and the outlet therein.

3. In pulverulent material classifying means as claimed in claim 2, a sleeve shaped baffle adjustably supported to have sliding movement within the second vertical wall portion of the housing and extend in angular relation to the inclining wall portion of the housing to control the quantity of coarse particles in the air-borne pulverulent material flowing to the outlet in the cylindrical casing portion.

4. In pulverulent material classifying means, a vertically disposed casing having outlets at the top and bottom and an annular passage in an intermediate portion thereof, an inlet conduit for air-borne pulverulent material extended through the bottom of the casing and terminating above the annular passage in the casing and having an annular opening in an intermediate portion thereof below the annular passage in the casing

for the discharge of reclassifying air into said annular passage, a member adjustably supported by the casing to have adjustment toward and away from the terminating end of the conduit and form with said terminating end an adjustable annular discharge opening extending in a horizontal plane for the discharge of the bulk of the air-borne pulverulent material delivered by the conduit, a member adjustably supported by the casing to have adjustment toward and away from the annular opening in the conduit to regulate the quantity of reclassifying air from the conduit to the annular passage, and annular baffles mounted in the casing in spaced horizontal alignment with said adjustable annular discharge opening and above the outlet portion of the annular passage to separate the coarse particles of material from the air-borne pulverulent material and direct the flow of air-borne pulverulent material to the outlet in the top of the casing and direct the coarse particles of material to the outlet in the bottom of the casing, and the reclassifying air flowing from the annular passage controlling the quantity of coarse particles of material discharged through the outlet in the top of the casing.

5. In pulverulent material classifying means as claimed in claim 4, a valve member adjustably supported by the casing in the outlet portion of the annular passage to regulate the velocity of the flow of reclassifying air from said annular passage.

GERHARD NIEMITZ.

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