

Oct. 30, 1934.

M. A. LISSMAN

1,978,801

CLASSIFIER

Filed Dec. 14, 1931

3 Sheets-Sheet 1

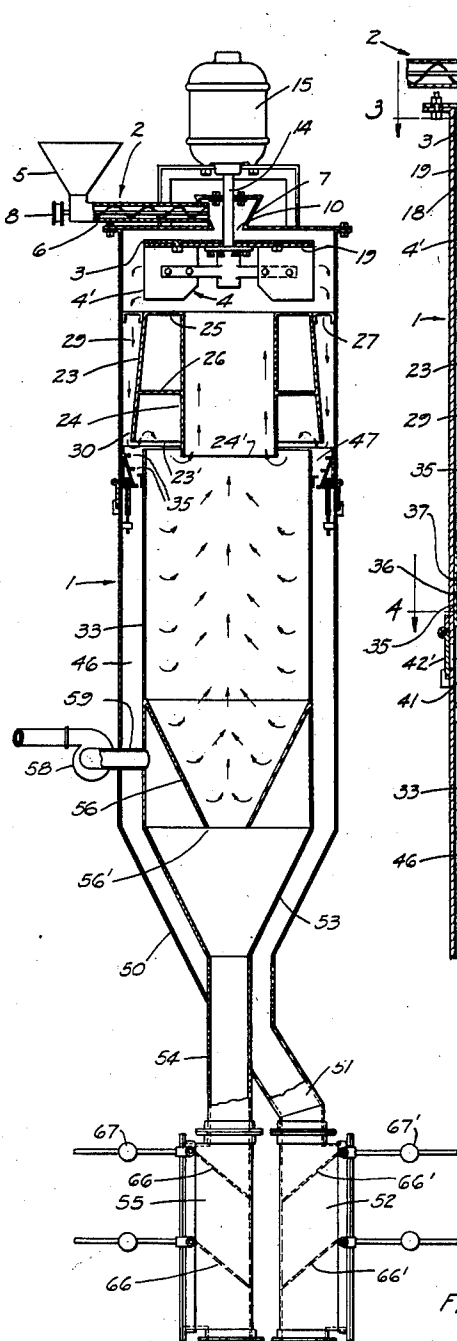


Fig. 1

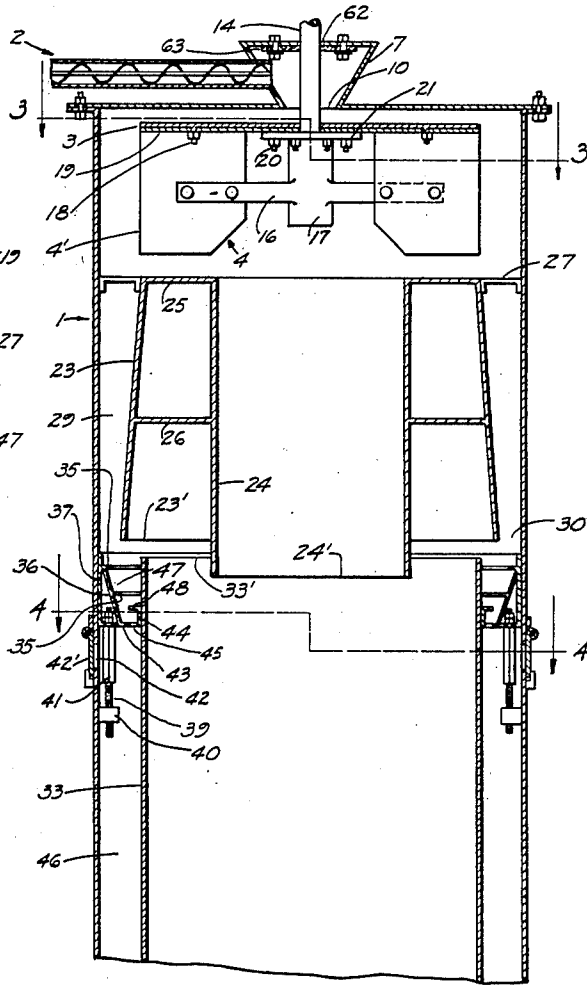


Fig. 2

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3 Sheets-Sheet 2

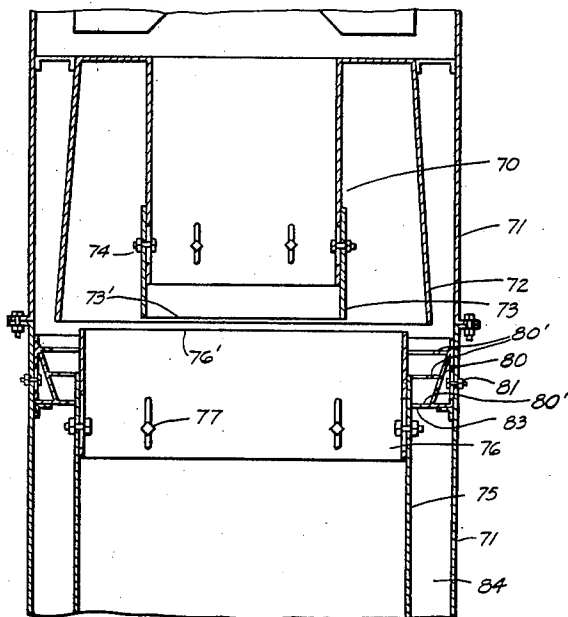
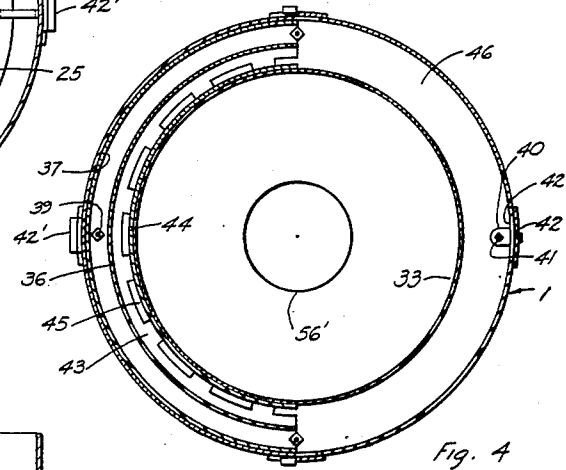
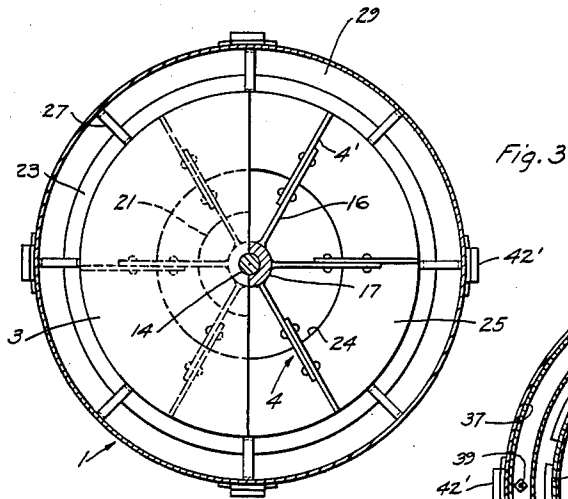


Fig. 5

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3 Sheets-Sheet 3

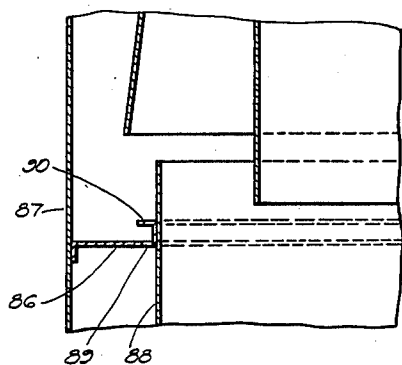


Fig. 6

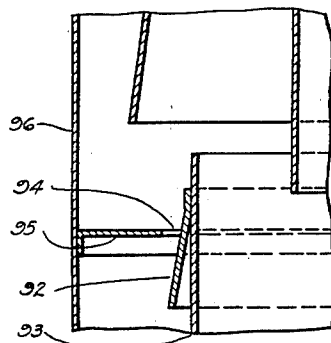


Fig. 7

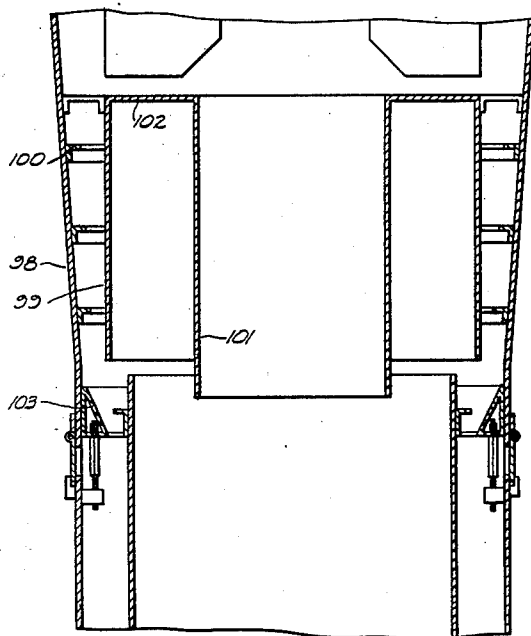


Fig. 10

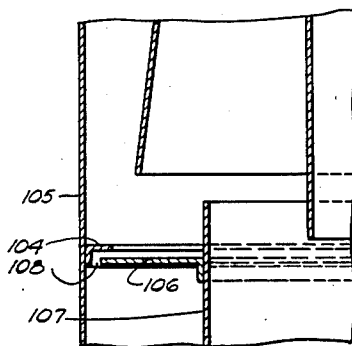


Fig. 8

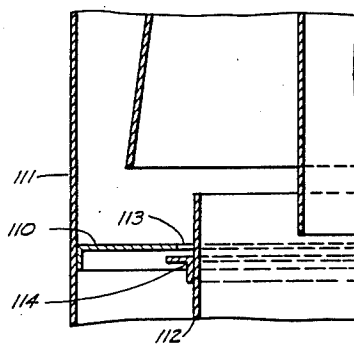


Fig. 9

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UNITED STATES PATENT OFFICE

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CLASSIFIER

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Application December 14, 1931, Serial No. 580,853

19 Claims. (Cl. 209—139)

This invention relates to improvements in classifiers, and the main object of the invention is to construct a classifier which will have large operating capacity, together with satisfactory sharpness of classification. A further object of the invention is to provide apparatus for this purpose which will be self-contained, so as to perform the classifying operation and the separate collection of the fines and of the coarse material in a single apparatus.

Another object of the invention is to provide a classifying apparatus which will be especially adapted for treatment of ground or other finely divided material in which the fines are more or less adherent to the coarser particles, the present invention providing for dislodging the fines from the coarser particles in the operation of the apparatus followed by separate collection of the fines and of the coarser particles.

The accompanying drawings illustrate the invention and referring thereto:

Fig. 1 is a vertical section of one form of the invention.

Fig. 2 is an enlarged vertical section of the upper part of the apparatus shown in Fig. 1.

Fig. 3 is a section on line 3—3 in Fig. 2.

Fig. 4 is a section on line 4—4 in Fig. 2.

Fig. 5 is a vertical section showing a modified construction of certain deflectors and passage means used in the apparatus.

Figs. 6 to 10 inclusive, are partial vertical sections showing other modifications of such deflector and passage means.

Referring to Figs. 1 to 4 inclusive, the classifier comprises a cylindrical casing 1, means 2 for feeding material to be classified into the upper part of said casing, a rotary distributor means 3 and impeller means 4 for distributing such material into the upper part of the casing and for producing the necessary air currents for the classifying operation, deflector means within the casing for controlling the path of such currents in such manner as to effect the classifying operation, and collecting means at the bottom of the casing for receiving the separated fines and coarse materials.

The feeding means 2 may comprise a hopper 5 for containing divided solid material, a conveyor 6 which may, for example, be a screw conveyor, for feeding the material from the hopper 5 to a feed chamber 7 at the top of the casing 1, and means indicated at 8 for operating said screw conveyor. The feed chamber 7 is closed at the top and opens at the bottom, as shown at 10, into the top of the chamber 1.

The distributing means consists of a disc or plate 3 mounted on a vertical shaft 14 and extending horizontally below the feed opening 10, said vertical shaft being operated at the proper high speed by any suitable driving means, such as electric motor 15, so that material passing through the opening 10 and falling on the central portion of the disc 3 will be caused to travel outwardly thereon and thrown therefrom by the action of centrifugal force, thereby distributing the material into the upper part of the chamber within cylindrical casing 1 and adjacent to the cylindrical wall thereof. The impeller means 4 is shown as comprising blades 4' carried by arms 16 on a hub 17 secured to the driving shaft 14 aforesaid, so that the distributing disc 3 and the impeller members are in rigid connection with one another and rotate together. The distributing disc 3 is shown as removably secured on top of the impeller by bolts 18 to a disc 19 which is fastened by bolts 20 to a flange 21 on hub 17 so that said distributing disc may be conveniently replaced in case of wear thereon.

Below the distributor and impeller means above described is mounted deflector means preferably comprising an outer frusto-conical shell 23 and an inner cylindrical return tube 24 connected together by webs 25 and 26 and mounted within the casing by bridge members 27 secured to members 1 and 23. The sleeve 23 preferably flares downwardly so that the annular space 29 between it and the casing 1 diminishes downwardly in radial dimension and terminates at its lower end in a comparatively narrow annular slot 30 between the lower edge 23' of member 23 and the cylindrical wall of casing 1.

A cylindrical separator member 33 extends within the lower part of casing 1 and coaxially therewith, the upper edge 33' of said member 33 being preferably nearly on the level with the lower edge 23' of member 23. In Figs. 1 and 2 of the drawings, said edge 33' is shown as somewhat below the edge 23', but it may, if desired, be on the same level or even a little above. The inner cylindrical member 24 is shown as having its lower edge 24' somewhat below the upper edge 33' of member 33. This is not necessarily the case, it being, however, desirable that the three edges 23', 33' and 24' shall be on nearly the same level so that the difference in height between said edges is small compared to the diameter of the casing 1. It is also desirable that the throat or narrow slot

30 shall be of radial depth which is small compared to the diameter of the casing 1.

The lower cylindrical separator 33 is preferably of somewhat less diameter than the lower edge of deflector member 23, so that gas and suspended material are required to move inwardly against the action of centrifugal force, between the edges 23' and 33', in order to enter the interior of separator 33. Furthermore, the inner return tube 24 is preferably of considerably less diameter than the cylindrical separator 33, so that the gas and suspended material passing inwardly over the top of separator 33 are caused to pass downwardly within separator 33, due to the centrifugal head, and then gradually inwardly and upwardly, instead of passing directly upward into the inner tube 24.

Below the slot 30 a deflector flange means is mounted within the casing 1, said flange means consisting, for example, of a plurality of horizontal flanges 35 extending inwardly from an inverted frusto-conical member 36 which is carried by a sleeve 37 mounted in contact with the wall of casing 1. In some cases it is desirable to provide for vertical adjustment of this deflector flange means, and for this purpose the sleeve 37 may be slidably mounted within casing 1 and be supported by screw means 39 working in threaded engagement with nut means 40 on the wall of the casing 1, said screw means 39 being provided with wrench holds 41 which are accessible through openings 42 in the wall of said casing, said openings being normally closed by doors 42'. The sleeve 37 is shown as provided with a bottom plate 43 having an up-turned flange 44 in sliding contact with the cylindrical separator member 33, said bottom plate being provided with openings 45 (see Figs. 2 and 4) through which coarse material may escape to the passage 46 below the deflector flange means and between the members 1 and 33. At the top of the flange means 44 a horizontal flange 48 is provided extending radially outward and somewhat above the openings 45.

Casing 1 is formed at its lower end with a funnel 50, opening at its bottom into a discharge pipe or chute 51, leading to a discharge gate means 52 for coarse material. The inner tube 33 is provided at its lower end with a funnel 53 opening at its lower end into a chute 54 for conducting fines to a discharge gate means 55. A conical outlet cone or funnel 56 is preferably provided within the tubular separator member 33 and extending from the wall of said member convergently downward to an outlet opening 56'.

In some cases it is desirable to provide for drawing off some of the gas within the classifier in order, for example, to prevent accumulation of moisture within the apparatus. For this purpose a blower or fan 58 may be provided whose inlet 59 is connected to the space within tubular member 33 and below the deflector means 56 aforesaid. Operation of this fan or blower also serves to produce a gradual descent of gas through the opening 56' and further facilitates the removal of fines from the gas in the upper part of tubular member 33. Withdrawal of gas from the classifying apparatus in this manner is compensated by any suitable means, for example, by intake of gas at an opening 62 in the top of the feed chamber 7 around the motor shaft 14, said opening being preferably closed by a flexible gasket 63 of leather or other suitable material fastened to the top of the feed chamber and in more or less closed engagement

with the shaft so as to prevent efflux of air or dust but yielding inwardly to permit air to pass into the interior of the casing 1 when required.

Any suitable discharge gate means may be provided for the fines and coarse material, the means shown comprising hinged gates 66 or 66' respectively, counter-weighted as shown at 67 or 67', so as to allow material to pass downwardly under its own weight, two of such gates being provided for each discharge means and located one above another so as to constitute an air lock for preventing any material influx or efflux of air during the discharging operation.

The operation of the apparatus above described is as follows: The impeller means 4 is rotated by the motor 15 at high speed, producing a centrifugal action on the air in the upper part of the casing or chamber 1, with the result that the air is forced to travel as indicated by the arrows outwardly toward the wall of casing 1, then downwardly through the vertical annular passage 29 and the annular throat 30, then inwardly under the lower edge 23' of deflector member 23 and over the upper edge 33' of tubular member 33 and after vortical movement within member 33, passing upwardly into the tubular member 24, the gas then ascending within the tubular member 24 to the central portion of the upper part of the chamber 1 completing the circulatory movement of the gas within the casing. The space within the upper part of casing 1 thus constitutes a circulation chamber.

The peripheral speed of the impeller 4 is much higher than in other forms of classifiers heretofore used, and is preferably 200 feet per second or more, and the initial tangential velocity of the gas flowing downwardly from the impeller is approximately equal to this peripheral impeller speed. The gas therefore leaves the impeller with sufficient energy to cause active whirling movement to be maintained throughout the above described path of circulation. It still possesses sufficient vortical motion when it passes over the upper edge of separator 33 to cause it to pass downwardly to a considerable depth within said separator, while also passing gradually inwardly and then upwardly therein to the return tube 24. The arrows in Fig. 1 represent only the components of this gas circulation in the plane of the drawing, without any attempt to indicate the rotational component which also persists throughout such circulation.

The material to be classified or separated is supplied by the feed means above described or by any other suitable means, to the upper part of the chamber or casing 1 above the rotating distributor disc 3, and by the rapid rotation of said disc is caused to travel outwardly thereover and caused to be discharged therefrom at high velocity in a tangential trajectory so that it impinges on the wall of the casing 1 at sufficiently high velocity to dislodge more or less completely the fines or flour material adhering to the coarser particles. The gas passing downwardly from the upper part of chamber 1 into the annular passage 29 carries with it the suspended material both coarse and fine and in passing downwardly in this manner the gas moves in a helical or vortical path at high velocity so that the suspended particles, particularly the heavier particles, are forced by centrifugal action toward and against the walls of casing 1, and the coarser or heavier particles

descend more or less gradually along the vertical wall of casing 1 and eventually slip or spill over the flanges 35 on the deflector means 36 and through passages 45 into the coarse material receiving space 46 from which it passes to the collecting means 52.

In this operation the horizontally extending lip or flange 44 over the openings 45 tends to prevent the heavier particles from being drawn back by entraining action of the gas current. The separation of the coarser particles as the gas passes under the lower edge of the member 23 is effected mainly by the centrifugal action on such particles due to their high vortical velocity tending to hold them outwardly toward the wall of casing 1, while the gas is forced inwardly by the suction from the impeller means and by the action of the deflector means 36; secondly, by the inertia or momentum of the coarser particles which tends to maintain their downward component of motion and thereby separate them from the gas stream which is deflected horizontally and upwardly by the deflector means 36 and 23, and separator means 33; and thirdly, by the action of gravity which tends to cause the coarser heavier particles to spill over the flanges 35 and through the outlets 45 as aforesaid. The throat 30 and the zone of classification indicated at 47 between the members 36, 23 and 33, are of small transverse dimension as compared to the diameter of the casing, and also as compared with the diameter of the members 24 and 33, so that a sufficiently high velocity of the gas is maintained at the throat 30 and in said separating and classifying zone to insure that the fines will be carried forward by the gas stream and the coarse particles will be forced out of the gas stream as above described.

The gas passes from the classifying zone under the lower edge 23' and into the cylindrical separator member 33, wherein it is subjected to a separating action by cyclonic or vortical motion, causing the fines to be separated therefrom to a greater or less extent, the relatively clean gas thence passing upwardly through the return tube 24. The separating operation in the separator member 33 is effected by the centrifugal action of the rapidly whirling gas within said member, it being understood that the gas enters the upper end of said separator member with the high tangential velocity together with a downward component of motion. This results in a pressure head representing an excess of pressure at the peripheral portion or zone of the vortically moving body of gas and a deficiency of pressure in the central portion or core of such body. As the gas descends in the cylindrical separator member 33, the tangential velocity is gradually decreased by reason of the friction against the wall of the separator member so that when the gas reaches the tapered outlet cone 56 at the bottom of said member, the radial pressure head thereon is sufficiently decreased to enable the longitudinal pressure head originally imposed upon the gas to force the gas inwardly as it descends in the outlet cone 56. The proportions of the parts are preferably such that the pressure at the periphery of the outlet opening 56' is somewhat greater than the pressure at the outlet tube 24, so that there is a positive ejecting action on the suspended particles at the peripheral portion of the outlet opening, it being understood that due to the vortical motion the suspended particles, being heavier than the

gas, are thrown outwardly into the peripheral zone adjacent the wall of the separating unit and descends along or adjacent such wall until they reach the outlet opening. Concurrently with the above-described operation, there is an inward flow of relatively clean gas toward the center of the separating member and upwardly to the return tube 24, and the stream of relatively clean gas passes upwardly through the said return tube.

It will be observed that both the relatively coarse particles separated from the gas in the classifying zone and the relatively fine particles separated in the separator 33 are removed from the gas before it returns to the impeller, so that only a very small proportion of the solid particles delivered to the apparatus are permitted to contact the impeller blades, and any such particles are necessarily extremely fine or light. For this reason, the wear on the impeller blades is substantially eliminated or reduced to a minimum, and this feature is of particular importance in view of the high speed at which the impeller is operated, for if any appreciable quantity of solids, and particularly the coarser solids, were permitted to contact the impeller blades moving at this high velocity, such blades would be worn away very rapidly. Any of the extremely fine particles which are carried up through the tubular member 24 will, however, be returned to the circulation and will eventually be separated from the gas as it repeatedly passes through the above described cycle.

By keeping the annular space between the external cylindrical casing 1, and the deflector means 23, of small radial depth, the rate of shear in the gas stream at the outside wall is kept very high. As a result, there is a zone immediately adjacent to the wall of deflector means 23, in which energy is dissipated at a high rate, thus creating a zone of strong eddies. These eddies agitate the material which tends to collect against the wall of casing 1, so that the fines adhering to the coarser particles are forcibly freed by attrition and carried towards the main gas stream by the eddies. The classifying zone is so proportioned and the component of velocity radially inwards is kept sufficiently high to carry along the particles which are of smaller diameter than those desired in the coarse cut. By keeping the tangential component of velocity in the classifying zone high, the particles are subjected to a high radial acceleration, many times that of gravity. This permits the inward component of velocity at the zone of classification 47 to be increased many times over that possible with low velocity classifiers. This results in a unit which is very compact for the tonnage which can be handled, as the weight of material which can be kept in suspension in a gas stream increases rapidly with increasing velocity, and while the energy required to keep a unit volume of gas in circulation at the higher velocity is increased, the weight of material classified per unit volume also increases.

The dispersion of the material to be classified is still further improved by the horizontal flanges 35', which force the material away from the external wall towards the more active zones of gas circulation, enhancing the chance of the fines being trapped and carried along by the main gas stream.

While the design is such as to create strong eddies in the dispersion zone adjacent the outer walls, sufficient tangential component of velocity

remains to obtain smooth stream lines of flow in the classification zone, without major eddies. The inertia of the larger particles makes them move downward away from edge 23' of the deflector 23, due to the downward component of velocity in the annular space between 1 and 23. The separation or classification zone 47 is so proportioned that the larger particles which it is desired to separate cannot reach the edge 33', but are thrown again into the inlet stream due to the high radial acceleration maintained in the classification zone. These proportions can be altered to suit different materials and to classify at different degrees of fineness by moving the flange means 35 up and down, also if desired by adjusting the upper edge of tubular member 33, as hereinafter set forth.

In practise the passage between edges 23' and 33' is made of sufficient radial depth to ensure that an oversized particle will be forcibly ejected out of the inner vortex moving towards the gas outlet of the classifying zone, before edge 23' is reached, and all such oversize particles eventually spill over the flange means 35 and pass to the coarse material outlet 51.

By reason of the fact that the classifying zone 47 adjacent the lower end of the tubular deflector member 23 extends approximately the full circumference of the apparatus, a comparatively large total cross-section of such zone with accompanying large operating capacity is secured, while at the same time the narrow transverse dimension of such zone between said lower edge and the deflector means 23 and 35 provides the high velocity and sharp curvature of motion which produces the close classifying effect desired.

If desired, provision may be made for adjustment of any of the deflecting means above described in addition to or alternatively with adjustment of the flange means which extend inwardly from the outer casing. Thus, as shown in Fig. 5, the inner tubular member 70, which is mounted coaxially within the outer casing 71 and the tubular deflector flange 72, may be provided with a downward extension 73 adjustably mounted thereon by bolt and slot connections 74, so as to adjust the lower edge 73' of the member 73 upwardly or downwardly to give optimum separating conditions. Similarly, the inner lower partition cylinder 75, which is mounted within the outer casing 71 below the tubular deflector means 72, may be provided with an adjustable extension 76 mounted thereon by bolt and slot connections 77 providing for vertical adjustment of the member 76 to bring its upper edge 76' to the most effective position. The flange means 80 extending inwardly from the outer casing 1, is also shown as mounted by bolt and slot connections 81 to provide for vertical adjustment of same. In this form of the invention said flange means is shown as provided with a plurality of horizontal flanges 80' and with passage means 83 between the lowermost flange means 80' and the inner cylinder 75 for passage of coarse material into the space 84 between the members 75 and 71. In other respects the construction and operation of this form of the invention may be the same as above described.

As shown in Fig. 6, the deflector flange means may consist of a horizontal flange 86 extending inwardly from the outer casing 87 to the inner lower partition cylinder 88, opening means 89 being provided near the inner edge of said flange

to permit passage of coarse material there-through. Said flange means may be provided with an outwardly extending flange 90 located over the openings 89 and serving to deflect the gas upwardly and the coarse material downwardly toward the openings 89. The construction of this form of apparatus may be similar to that above described and the operation is also similar, it being understood that in practice more or less coarse material will generally accumulate on the flange 86 in a layer whose slope corresponds to the angle of repose of the coarse material under the conditions present.

As shown in Fig. 7, an apron 92 may extend downwardly and outwardly from the lower partition cylinder 93 adjacent the passage means 94 between said cylinder and the horizontal deflector flange 95 which extends inwardly from the outer casing 96, this apron permitting descent of coarse material but tending to obstruct the return of coarse material through said passage means.

It is preferred to so construct the apparatus that the annular passage between the outer casing and the tubular deflector decreases in radial dimension toward the bottom, so as to produce maximum speed at the throat where the gases leave such annular passage and enter the classifying zone. In the form shown in Fig. 1, this effect is secured by increasing the diameter of the tubular member 23 toward its lower end, but as shown in Fig. 10, the same effect may be secured by decreasing the diameter of the outer casing 98 from the upper part of the circulation chamber to the bottom of the tubular deflector means 99. Also, as illustrated in this figure, horizontal flanges or baffles 100 may be provided within said annular passage, said horizontal flanges extending inwardly from the wall of casing 98 and forming obstructions which force the gas and the material carried thereby momentarily away from the wall 98, thereby producing eddies which aid in knocking off the finer particles which tend to adhere to the coarse particles. In this figure, the inner tubular return member 101 is shown as connected to the outer deflector member 99 by single web 102 at the upper end thereof, it being understood that the space between these inner and outer tubular members is substantially a dead space and it is immaterial whether or not an intermediate partition is used as shown in Fig. 1. Also, as illustrated in this figure, the flange member indicated at 103 may be formed as a plain cone without horizontal flanges, the construction and mounting of such flange member being otherwise as above described.

The deflector flange means extending inwardly from the outer casing in the forms of the invention above-described operates as a trap for selectively removing the coarse particles of a gas stream and allowing such particles to fall into the coarse material discharge means. Any suitable flange means may be used for this purpose, for example, such means may comprise an outer flange 104 extending inwardly from the outer casing 105 and an inner flange 106 extending outwardly from the inner partition member 107 somewhat below the flange 104 and spaced therefrom to form a discharge outlet 108 for coarse material. In Fig. 8 the discharge outlet 108 is near the wall of the outer casing, the flange 104 being relatively narrow and the flange 106 being relatively wide, but if desired the discharge outlet for coarse material may be located

near the inner member as shown in Fig. 9, the upper flange 110 extending from the outer casing 111 nearly to the inner partition cylinder 112 leaving a discharge outlet 113 between said parts and the lower flange 114 is relatively narrow and extends from the inner member 112 directly under the discharge outlet 113.

In the drawings, the casing of the apparatus is shown as mounted with its cylindrical axis vertical, this being generally the most convenient arrangement and permitting the action of gravity to reinforce to some extent the classifying and separating actions. However, my invention is not limited to such an arrangement, as the casing and the tubular members associated therewith may extend horizontally or at any desired inclination, modifications being made where necessary in the feeding and discharging means for the divided material, it being understood that the gravitative action is small compared to the centrifugal forces exerted as above described in the classifying and separating operations and will be effective irrespective of the angular position of the apparatus. It will be further understood that the components of motion which tend to move the suspended material either coarse or fine as the case may be, toward the discharge or outlet means therefor, are not necessarily vertical, but, in any case, such components are longitudinal or parallel to the axis of the apparatus, as distinguished from the tangential components which tend to separate, first, the coarse, and later, the fines, from the gas stream.

In the drawings I have shown the means for distributing the material to be classified into the casing as consisting of a rotary distributor. It will be understood, however, that any suitable means may be provided for feeding such material into the casing adjacent the rotary impeller and either at the central portion or at the peripheral portion or at any intermediate portion of the casing.

I claim:

1. A classifier comprising a cylindrical vertical casing forming at its upper portion a circulation chamber, a rotary distributor at the upper part of said chamber for distributing therinto divided material to be classified and for causing such material to impinge on the wall of said chamber, rotary impeller means directly beneath said distributor means for causing vortical circulation of gas within said chamber in such manner that the gas moves with tangential and downward components of motion adjacent the wall of said chamber and upwardly in the central portion of said chamber, tubular deflector means extending adjacent the wall of the circulation chamber to form an annular passage open at top and bottom, annular flange means extending inwardly from the wall of said chamber below said annular passage and providing passage means for passage of coarse material, and a cylindrical separator member mounted coaxially in aforesaid casing below the circulation chamber, the space between said separator member and the casing constituting a coarse material collecting chamber communicating with the space above the annular flange means to receive coarse material therefrom and the space within said separator member constituting a fines collecting chamber.

2. A construction as set forth in claim 1, in which the flange means, the lower edge of the tubular deflector means and the upper edge of

the partition member are approximately at the same level and are spaced apart distances which are small compared to the diameter of the casing, so as to provide between them a classifying zone in which the gas is subjected to sudden inward and upward acceleration and the coarse particles are separated by the action of centrifugal force, downward momentum and gravity.

3. A construction as set forth in claim 1 and comprising, in addition, a return tube within the tubular deflector for conducting the gas upwardly to the central portion of the impeller means, the lower edge of said return tube being approximately at the level of the lower edge of the tubular deflector.

4. A construction as set forth in claim 1, and comprising, in addition, means for vertical adjustment of the annular flange means.

5. A construction as set forth in claim 1, wherein said annular flange means comprises a plurality of horizontal flanges at different levels.

6. A construction as set forth in claim 1, wherein said annular flange means comprises a plurality of horizontal flanges at different levels and of successively smaller internal diameters in descending order.

7. A construction as set forth in claim 1 and comprising in addition, flange means extending outwardly over the passage means for coarse material.

8. A classifier, comprising a cylindrical vertical casing forming at its upper portion, a circulation chamber, means for distributing into the upper portion of said chamber divided material to be classified and for causing such material to impinge on the wall of said chamber, rotary impeller means for causing vortical circulation of gas within said chamber in such manner that the gas moves with tangential and downward components of motion adjacent the wall of said chamber and upwardly in the central portion of said chamber, tubular deflector means disposed below said material distributing means and extending adjacent the wall of the circulation chamber to form an annular passage open at top and bottom, annular flange means disposed below said tubular deflector means and extending inwardly from the wall of said chamber below said annular passage and providing passage means for passage of coarse material, and a cylindrical separator member mounted coaxially in the aforesaid casing below the circulation chamber, the space between said separator member and the casing constituting a coarse material collecting chamber communicating with the space above the annular flange means to receive coarse material therefrom, and the space within said separator member constituting a fines collecting chamber.

9. A classifier comprising a substantially cylindrical vertical casing, rotary impeller means positioned within the upper portion of said casing for causing vortical motion of gas therein downwardly adjacent the wall of said casing and upwardly in the central portion thereof, means for distributing divided material to be classified into the downwardly moving gas stream adjacent the wall of the casing, tubular deflector means extending downwardly from said rotary impeller and disposed concentrically within and adjacent said casing and providing a restricted annular opening between the lower edge of said deflector means and said casing, a tubular separator disposed below said deflector means and concen-

- trically within said casing and of somewhat less diameter than said deflector means so as to define an annular classification chamber between said casing and the lower edge of said deflector means and the upper portion of said tubular separator, an inner return tube disposed concentrically within said deflector means and of less diameter than said tubular separator, and transverse partition means extending across between said inner return tube and said deflector means to substantially prevent upward flow of gas therebetween.
10. A classifier as set forth in claim 9 and also comprising separate material receiving means disposed below said annular classifying chamber and below said tubular separator respectively.
11. A classifier as set forth in claim 9, the lower edges of said tubular deflector means and said inner return tube and the upper edge of said tubular separator being disposed approximately at the same level.
12. A classifier as set forth in claim 9, said restricted annular opening between the lower edge of said deflector means and said casing being of relatively small radial dimension as compared to the diameter of said casing.
13. A classifier as set forth in claim 9, said classification chamber between said casing and the lower edge of said deflector means and the upper portion of said tubular separator being of relatively small radial dimension as compared to said casing.
14. A classifier as set forth in claim 9, and also comprising deflector flange means extending inwardly from said casing below said classification chamber, an opening being provided between said casing and said tubular separator for permitting downward movement of separated material below said deflector flange means.
15. A classifier as set forth in claim 9, and comprising in addition, deflector flange means extending inwardly from said casing and additional flange means projecting outwardly from said tubular separator, both of said flange means being disposed below said classification chamber and being so disposed as to provide an opening therebetween for downward passage of separated material.
16. A classifier as set forth in claim 9, and comprising in addition, means for removing gas from the lower portion of the interior of said tubular separator.
17. A classifier as set forth in claim 9, and comprising in addition, a downwardly and inwardly inclined baffle disposed within the lower portion of said tubular separator and providing a restricted central outlet opening for separated material, and means for withdrawing gas from the interior of said tubular separator below said baffle.
18. A classifier comprising a casing of circular cross-section whose upper portion constitutes a circulation chamber, rotary impeller means for causing vortical circulation of gas within said chamber in which the gas moves downwardly with a whirling motion adjacent the wall of said casing and upwardly with a whirling motion within the central portion of said casing, means for distributing mixed coarse and fine divided material to be classified into the downwardly moving gas stream, at a position outwardly of said impeller means, a separating member of circular cross-section disposed concentrically within said casing below said circulation chamber, the annular space between said casing and said separating member constituting a collecting chamber for coarse material, and the space within said separating member constituting a collecting chamber for fine material, and separate means for discharging material from said two collecting chambers.
19. A classifier as set forth in claim 18 and also comprising deflecting flange means extending inwardly from the wall of said casing adjacent the upper edge of said separating member and providing a restricted opening through which separated coarse material may pass to the collecting chamber therefor.

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