Jan. 6, 1953 A. M. ANDRIES 2,624,516

FLUID IMPACT PULVERIZER AND SEPARATOR

Filed Jan. 4, 1949

2 SHEETS—SHEET 1

Fig. 1

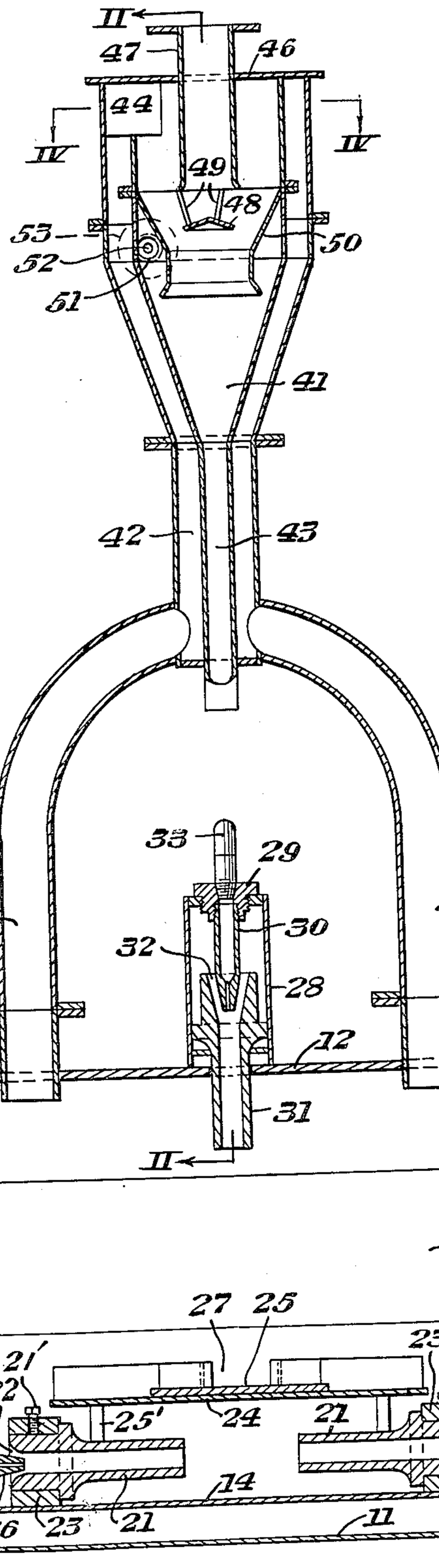


Fig. 4

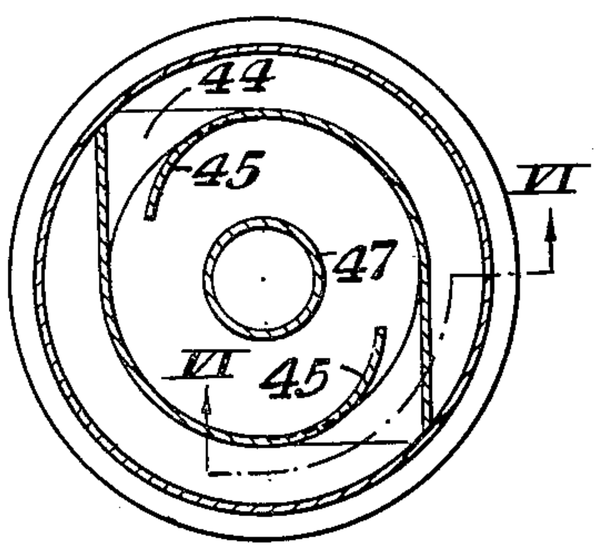


Fig. 5.

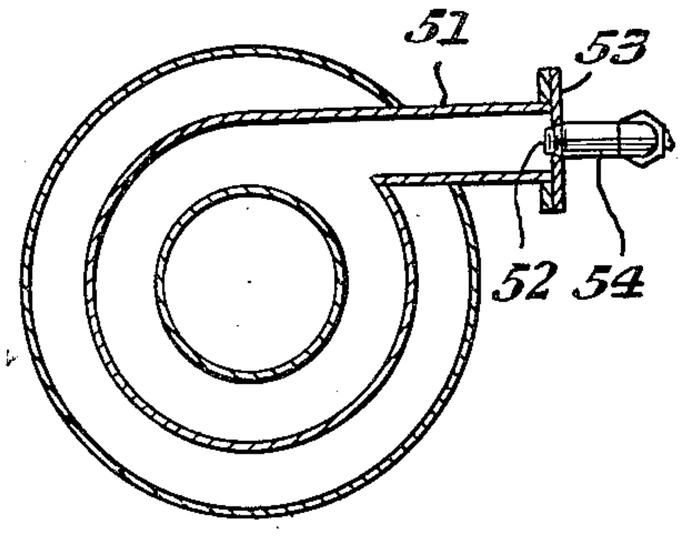
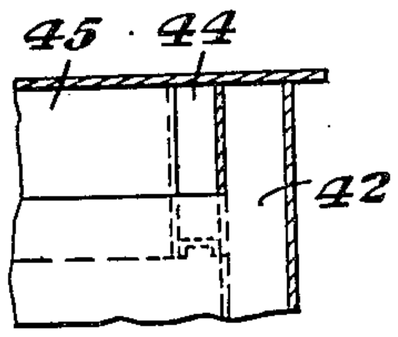


Fig. 6.



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FLUID IMPACT PULVERIZER AND SEPARATOR

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Fig. 3.

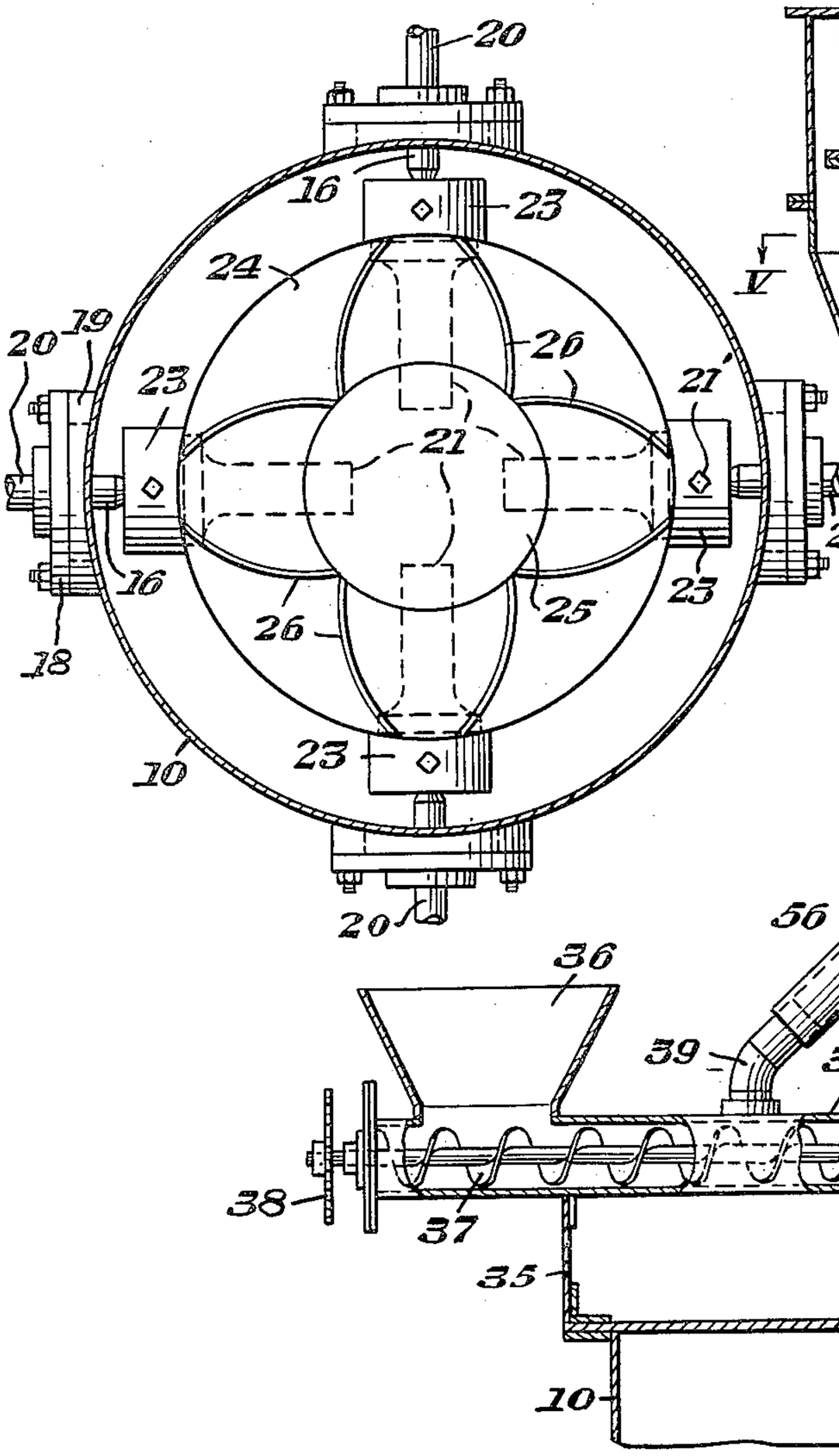
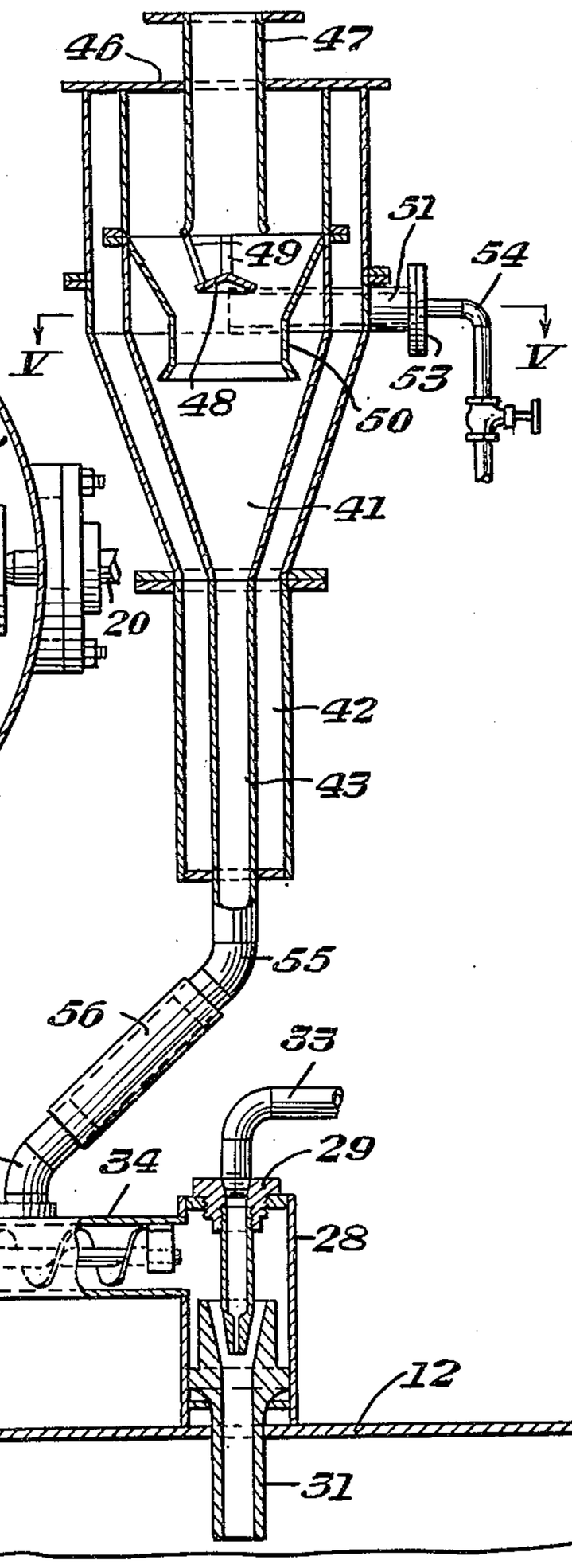


Fig. 2.



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UNITED STATES PATENT OFFICE

2,624,516

FLUID IMPACT PULVERIZER AND SEPARATOR

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Application January 4, 1949, Serial No. 69,103

6 Claims. (Cl. 241—39)

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This invention relates to mills of the impact pulverizer type. More particularly, it relates to a mill in which streams of a gaseous atmosphere in which coal or coke is suspended are directed toward a common point to cause the comminution of such material to desired particle size.

In general, such pulverizers produce fine grinding of such solid material by turbulence in the gaseous atmosphere carrying the fragments of such material or by the colliding action of the streams within the apparatus carrying such material. Thus particles may collide with one another when moving in opposite or converging directions or may collide with some portion of the apparatus and thus be subject to fracture. Further, such particles may impinge upon one another or upon a portion of the apparatus with glancing blows and be reduced in size by attrition.

In mills of the type with which this invention is concerned, these particles are entrained in the gaseous atmosphere by jets or ejectors directed so as to have a common intersection. In order to grind to a sufficient degree of fineness, the coarser particles are recirculated to such jets until reduced to the desired degree. The gaseous atmosphere is produced and maintained as the consequence of the operation of the jets with superheated steam or compressed air. These gaseous fluids, inclusive of such vapors as may be present, inspirate the particles of coal, coke or other solid fuel to be ground and cause them to be suspended in the streams of gaseous fluid and particles so created.

In this invention more efficient provision is made for feeding fresh coal or coke fragments and recirculating too coarse ground particles to the grinding jets and for separating pulverulent material meeting specification without excessive rejection. Further, in the mill of this invention a wide range of such fuels of different character can be ground to predetermined particle size. Other objects and advantages of this invention will be apparent from the following description and from the drawings, in which,

Figure 1 is a vertical view in cross section of a mill made in accordance with this invention including the separator associated therewith;

Figure 2 is a view in cross section taken along line II—II of Figure 1;

Figure 3 is a view in cross section taken along line III—III of Figure 1;

Figure 4 is a view in cross section of the separator taken along line IV—IV of Figure 1;

Figure 5 is a view in cross section taken along line V—V of Figure 2; and

Figure 6 is a vertical view in cross section taken along line VI—VI of Figure 4.

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Referring to the preferred embodiment shown in Figures 1 to 6, a cylindrical casing 10 is composed of a number of ringlike sections either bolted or welded together in leakproof fashion. Casing 10 together with bottom 11 and a top plate 12 define a grinding chamber 13 in which there is a false bottom 14. Around the lowermost section of casing 10 there are four circular openings 15 through each of which a nozzle 16 projects. Each nozzle 16 is held in a block 17 threadably connected to a plate 18 which is bolted in sealed engagement with an annular rim 19 welded to casing 10 around each opening 15. Superheated steam or compressed air is supplied to nozzles 16 through the respective pipes 20. For grinding coal compressed air is usually supplied to nozzles 16. Nozzles 16 are horizontally directed toward a common intersection, the point center of which lies on the vertical axis of chamber 13.

Each nozzle 16 is provided with a coaxially positioned barrel 21 pointing toward said common intersection and spaced in advance of the respective nozzle 16 an amount which provides an annular inlet 22 which constitutes part of the inspiration zone for each grinding jet or ejector comprising a nozzle 16 and its attendant barrel 21. Each barrel 21 is affixed and held in place by set screws 21′ in the bore of a bracket 23 fastened to bottom 14.

A circular baffle plate 24 is located in a horizontal plane above the respective barrels 21, where it is held in place over said barrels by legs 25′. Each leg 25′ is welded or otherwise fastened respectively to a barrel 21 and baffle plate 24. A wear plate 25 is affixed to baffle 24 on the top side thereof in the center to prevent undue wear of baffle 24.

Four pairs of curved vanes 26 are affixed to the top of baffle 24 in an upstanding position. They form a series of four channels 27, the axis of each of which overlies the axis of its respective barrel 21. In plan, vanes 26 outline a set of four cusps or foils arranged around wear plate 25, the bases and peaks of which cusps are open. Hence, solid material impinging on wear plate 25 is guided by such channels to their respective inspiration zones 22 adjacent the open delivery end of each channel. Since adjacent vanes of adjacent cusps practically touch at their inner ends, the likelihood of material moving over the top of baffle 24 other than in one of the channels is minimized. The walls of the channels may, of course, be straight vanes converging toward each other at the outer ends thereof. The height of such vanes 26 is proportioned to the forces encountered.

A housing 28 is located in the center of the top of plate 12. The housing supports a nozzle block 29 in which a nozzle 30 is threaded. Housing 28 also supports a barrel 31 projecting downwardly through plate 12 at right angles to wear plate 25. Barrel 31 is spaced from nozzle 30 to provide an annular inlet 32 which is part of the inspiration zone for the feed jet or feed ejector which comprises nozzle 30 and barrel 31. Gaseous fluid to operate nozzle 30 is supplied through a line 33. I have found it advantageous to provide the channels 27 on baffle plate 24, although the combination, broadly, of a wear plate and vanes adjacent a baffle interposed between the common intersection of the recirculating ejectors and the feed ejector is a part, not of this invention, but of the invention shown and claimed in United States patent application, Serial No. 69,127, filed on even date herewith, in the name of William Mayo Venable.

Housing 23 has an opening on one side thereof adjacent inspiration zone 32 to which opening there is connected a feed conduit 34. A bracket 35 fastened to the edge of plate 12 supports conduit 34. The outer end of conduit 34 is opened for connection to a flared hopper 36 to which fresh material is supplied. A screw conveyor 37 is rotatably supported in conduit 34 and is turned by a sprocket 38 on the shaft thereof for material advancing engagement with the inside of conduit 34. Intermediate the ends of conduit 34 in advance of hopper 36 there is a pipe connection 39 leading to a separator. Other feeding means for supplying solid material to inspiration zone 32 or directly into chamber 13 may also be used.

Entrained ground material when sufficiently fine enough leaves chamber 13 borne by the gaseous fluid passing through chamber 13 and out through an outlet comprising a pair of uptakes 40. These uptakes are joined at their upper ends by a separator 41. Separator 41 comprises a funnellike outer annular passage 42 and a concentric inner passage 43. These passages open into each other at their respective upper ends through an opening 44 in which there are curved directing vanes 45 to impart rotary motion in one direction about the vertical axis of separator 41 to the stream of gaseous fluid and entrained ground material rising in passage 42. The top of both passages is closed by a plate 46 in the center of which there is a riser pipe 47 which projects downwardly into inner passage 43 below opening 44. A bell type shield 48 is suspended by brackets 49 from the lower end of riser 47.

An inner funnel 50, substantially in the form of an inverted cone, is suspended in the upper flared portion of inner passage 43 substantially at the level of the lower end of riser 47. A horizontal and tangential conduit 51 passes through outer passage 42 and opens into inner passage 43 between the circular wall thereof and the exterior of funnel 50. Gaseous fluid, preferably superheated steam, is fed into conduit 51 through an inlet 52 supported in cap plate 53 which closes the outer end of conduit 51. The gaseous fluid is supplied to inlet 52 by a pipe 54. The horizontal direction of rotation of the gaseous fluid issuing from inlet 52 is the same direction of rotation as that imparted by vanes 45 to the stream passing through opening 44 from passage 42. Hence, additional momentum of such stream is created in separator 41 resulting in more solid material passing upwardly in riser 47 while suspended in the gaseous fluid than would otherwise be the case, and thereby increasing the capacity of the

mill. Such pulverulent material rising in riser 47 includes all particles of a predetermined size or less and avoids any unduly narrow range of material capable of suspension and upward removal within inner passage 43 through riser 47. Thus, the heavier material of larger particle size passing downwardly through funnel 50 in passage 43 and into a downcomer 55 is kept to a minimum commensurate with the size which the pulverulent material must not exceed. Since downcomer 55 is connected to pipe 39 by a sleeve 56, such ground material rejected by separator 41 is returned to conduit 34 where it is admixed with the fresh material being fed to inspiration zone 32 whence it is recirculated and reground until it meets specification.

It is evident that the proportions of the various parts and openings of apparatus made in accordance with this invention are matters within the scope of engineering skill. Thus the proportions of the vanes 26, uptakes 40, separator 41 and its parts and of the feeding mechanism will be determined in the light of the particular character of the fuel to be ground, the nature of the gaseous fluid or fluids used in the respective jets, the pressures, temperatures and the like to be encountered and the size of the apparatus. Such particulars constitute the field of process engineering and in such connection all of the drawings in this case are to be considered as merely diagrammatic. All portions of the apparatus will also be suitably insulated where necessary to prevent undue loss of heat.

Although I have illustrated and described but a preferred practice and embodiment of the invention, it will be recognized that changes in the procedure and structural details may be made without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. Apparatus for pulverizing and separating material comprising in combination, a substantially open impact pulverizing chamber, a plurality of opposed generally horizontal grinding and recirculating ejectors having a common intersection in said chamber, an ejector for feeding material into said chamber, said ejector being substantially directed toward said plurality of recirculating ejectors, a baffle interposed between said recirculating ejectors and said feeding ejector, said baffle being above said common intersection, pairs of upstanding walls on said baffle on the side away from said recirculating ejectors, said walls forming radial channels which narrow as the distance from the center of the baffle increases, an outlet end for each channel being positioned substantially adjacent one of said recirculating ejectors, at least one uptake connected to said chamber, a separator connected to said uptake to remove pulverulent material from the stream in said uptake, a downcomer to lead off rejected material from said stream, mechanical means for feeding material to said feeding ejector, said mechanical means being connected to said downcomer to receive the material passing therethrough, whereby said recirculating ejectors are continuously supplied with fresh and recirculated material guided by said channels.

2. Apparatus for pulverizing and separating material comprising in combination, an open grinding chamber, a plurality of opposed generally horizontal grinding jets having a common intersection in said chamber, a horizontal baffle positioned above said common intersection and substantially covering the area between said jets,

curved upstanding vanes forming a series of cusps around the center of said baffle on the side away from said jets, said cusps being open at the respective bases and peaks thereof and coinciding with the axes of said jets, a feed jet directed at said baffle adjacent and between said bases, at least one uptake around the periphery of said chamber adjacent the top, a separator having spaced walls forming an inner and an outer passage, said outer passage being concentric with said inner passage, said inner passage having rotational vanes therein, a riser for pulverulent material extending downwardly into said inner passage, funnel-like member within said passage beneath said riser, a generally horizontal tangential gaseous fluid inlet pipe in said inner passage positioned exteriorly of said funnel-like member, said inlet pipe imparting a motion to a gaseous fluid passing therethrough in a direction concurrent to the direction of motion imparted by said vanes, a screw conveyor for feeding material to said feed jet, said screw conveyor being connected to the lower portion of said inner passage, whereby a flow of fresh said material including material rejected by said separator is jetted against said baffle, guided by said cusps into said grinding jets, ground and the pulverulent material separated in said separator.

3. In apparatus for pulverizing and separating material, an impact pulverizing section comprising, a substantially unconfined impact grinding chamber, a plurality of opposed generally horizontal grinding ejectors adjacent the bottom of said chamber, said grinding ejectors being directed toward a common intersection, a feeding ejector for said material directed toward said common intersection and adapted to supply material to said chamber, a baffle interposed between said grinding ejectors and said feeding ejector, said baffle further being above and covering said common intersection, a series of pairs of upstanding generally outwardly extending vanes on the side of said baffle away from said grinding ejectors and forming outwardly extending channels, said channels being open at both ends and having the delivery end of each thereof adjacent the intake zone of a respective grinding ejector, and an uptake from said chamber, whereby material jetted into said chamber by said feeding ejector is guided toward said grinding ejectors by said channels.

4. In apparatus for pulverizing and separating material, a separator comprising spaced walls forming an outer passage and a concentric inner passage, said passages being opened into each other adjacent the tops thereof, spaced opposed vanes extending from the interior wall of said outer passage into said inner passage and curved in the same direction about the center of said inner passage to define said opening and impart rotation in said direction to said material, a riser for pulverulent material of a predetermined particle size extending downwardly through said opening, an inverted generally inwardly and downwardly extending member in said inner passage beneath the lower end of said riser, and a generally horizontal and tangential gaseous fluid inlet pipe in said inner passage exteriorly of said member, said inlet pipe imparting motion to the gaseous fluid passing therethrough in the said direction, whereby pulverulent material of greater particle size may be removed through said riser.

5. In apparatus for impact pulverizing and separating material, a separator comprising spaced walls forming an outer passage and a concentric inner passage, said passages being opened into each other adjacent the tops thereof, spaced opposed vanes extending from the interior wall of said outer passage into said inner passage and curved in the same direction about the center of said inner passage to define said opening and impart rotation in said direction to said material, a riser for pulverulent material of a predetermined particle size extending downwardly through said opening, an inverted conical member in said inner passage beneath the lower end of said riser, a substantially horizontal and tangential gaseous fluid inlet pipe in said inner passage exteriorly of said conical member, said inlet pipe imparting motion to the gaseous fluid passing therethrough in the said direction, and a conveyor for feeding fresh material to said apparatus, said conveyor being also connected to the lower end of said inner passage to receive the heavier separated material therefrom.

6. In apparatus for impact pulverizing and separating material having an impact pulverizing chamber, a separator and feeding mechanism comprising spaced walls forming an outer passage and a concentric inner passage, said passages being opened into each other adjacent the tops thereof, spaced opposed vanes extending from the interior wall of said outer passage into said inner passage and curved in the same direction about the center of said inner passage to define said opening and impart rotation in said direction to said material, a riser for pulverulent material of a predetermined particle size extending downwardly through said opening, an inverted conical member in said inner passage beneath the lower end of said riser, a substantially horizontal and tangential gaseous fluid inlet pipe in said inner passage exteriorly of said conical member, said inlet pipe imparting motion to the gaseous fluid passing therethrough in the said direction, a feeding jet for supplying material to said chamber, said jet having an inspiration zone, a screw conveyor for feeding material to said inspiration zone, a conduit for supplying fresh material to said screw conveyor, a conduit connecting said screw conveyor intermediate the ends thereof with said inner passage, whereby separated material heavier than said pulverulent material of a predetermined particle size is returned to said screw conveyor for admixture with said fresh material before return to said chamber.

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