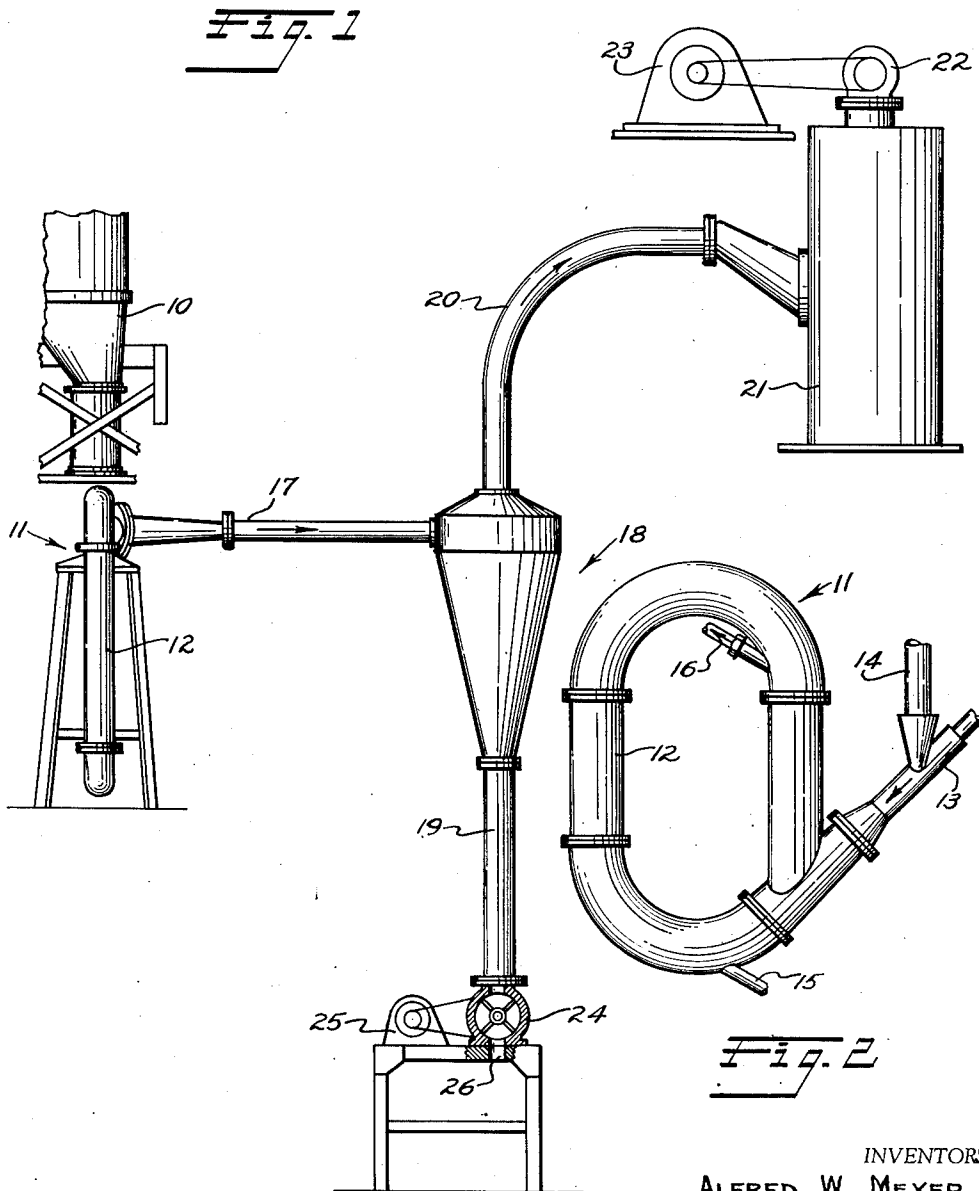


Jan. 4, 1955

A. W. MEYER ET AL
COMMINUTING APPARATUS

2,698,718

Filed June 22, 1951



INVENTORS
ALFRED W. MEYER
PETER C. FIRING

BY *Benitella*
Agent.

1

2,698,718

COMMUNUTING APPARATUS

Alfred W. Meyer and Peter C. Firing, Matawan, N. J., assignors to National Lead Company, New York, N. Y., a corporation of New Jersey

Application June 22, 1951, Serial No. 233,091

2 Claims. (Cl. 241—39)

The present invention relates to the preparation, classification and collection of finely divided particles or powders.

Many industrial processes and commercial products require the use of materials in finely divided or powdered form. Various processes and mills for reducing materials to a finely divided state are known but these prior processes and mills have been generally characterized by slow through-put speeds which increase the cost of production of the powders. Efforts to increase the through-put speeds of such mills have generally involved disproportionate increases in power or steam consumption.

According to the present invention materials are reduced to powders with a high through-put speed without adversely affecting the particle sizes or increasing material losses and with minimum increase in power or steam consumption.

One of the objects of the present invention is to provide a method and apparatus for reducing material to a powder at high speed and with high efficiency.

Another object is to provide a method and apparatus for increasing the through-put speed of a jet mill or the like.

Another object is to provide an improved method and apparatus for separating fine particles or powders from air or gas.

Another object is to provide an improved method and apparatus for reducing material to a fine powder and collecting the powder with maximum efficiency.

These and other objects and advantages reside in novel features of construction, arrangement and combination of parts and in steps and processes as hereinafter more fully set forth and pointed out in the appended claims.

Referring to the drawing:

Figure 1 is a diagrammatic elevation of one form of apparatus for carrying out the present invention.

Figure 2 is a side elevation of one form of mill used in the practice of the present invention.

The present invention may be used for the reduction of particles to a finely powdered form, as for example, the reduction of granules or crystals of metal salts or oxides to fine powders for use as paint pigments. The material to be reduced is fed from a bin or hopper 10 to a mill such as the jet mill indicated generally at 11. The specific construction of the jet mill forms no part of the present invention and various suitable forms of jet mills are known in the art and are commercially available. United States Letters Patent No. 2,284,746 illustrates one typical form of jet mill.

Referring to Figure 2, the mill 11 comprises a tubular chamber or ring 12 which is usually formed to provide a closed endless circuit for the material being reduced. Steam, air or other suitable gas enters the mill 11 under pressure through a pipe 13 from a suitable source not shown and the material to be reduced is introduced into the pipe 13 from the hopper 10 through a pipe or conduit 14 and is entrained in the moving stream of steam or other gas. Usually a nozzle or restriction, not shown, is located in the pipe 13 adjacent the pipe 14 to provide aspirator action to draw the material to be reduced into the moving stream of gas or steam.

Generally only a part of the gas or steam is introduced through the pipe 13 and the remainder is introduced directly into the ring or chamber 12 through one or more pipes 15 which may project a short distance into the chamber 12. The relative amounts of gas or steam entering through pipes 13 and 15 may be varied but generally

2

it is preferable to inject the major portion of the steam or gas through pipe 15. In one such mill, satisfactory operation and economy are obtained by injecting 1/3 of the steam through pipe 13 and the remainder through pipe 15.

The material is reduced by attrition during its passage around the chamber or housing 12 and the finely powdered material leaves the chamber or housing 12 through a pipe or conduit 16 from the inner portion of the housing 12. The operation of the jet mill and the manner in which the reduction takes place is well known in the art.

From the mill 11, the powdered material passes through a conduit 17 to a cyclone separator 18 in which the powdered material is removed from the moving stream of gas. As is known in the art, the powdered material drops down through the conduit 19 and is collected and the gas is exhausted through the pipe or conduit 20. The exhaust steam is preferably condensed in a chamber 21 and any entrapped particles not separated out in the cyclone separator 18 settle to the bottom of this chamber 21.

The system thus far described will reduce the material to suitable size but it has been found that the through-put speed of the system can be materially increased, the collecting efficiency improved, and particle size and classification more uniformly controlled.

According to the present invention, a suction or vacuum is applied to the exhaust from the cyclone separator 18. As shown in Figure 1, this suction or vacuum may be applied by a pump 22 connected to the outlet of the gas washer 21 and driven by a suitable source of power such as an electric motor 23. Other suitable apparatus for applying vacuum such as fans, blowers, or the like may of course be used.

A rotary air lock or valve 24 driven by a suitable motor 25 is provided at the bottom of the conduit 19. This valve 24 permits the separated powder to drop through the opening 26 where it is collected but prevents air from entering the cyclone separator 18 through the conduit 19.

The application of even a relatively small vacuum affects the entire system and brings about unexpected improvements in control, operation and results without any increase in steam or gas consumption. Because of the reduction in pressure, the pressure energy of the steam or gas entering the mill through pipe 13 is more completely converted to velocity energy so that more rapid and more efficient comminution of the particles is obtained.

Reduction of pressure at the outlet of the cyclone separator 18 reduces turbulence in the separator with the result that more uniform and efficient separation is obtained. In addition, the through-put speed of the material from the entrance at pipe or conduit 14 to the discharge at opening 26 is greatly increased. For example, in one installation, the through-put of material was raised from approximately 29 tons of powder per day to approximately 37.8 tons per day by the application of a relatively low vacuum without changing the steam or gas pressure at the mill inlet 13. This low vacuum reduced the pressure at the mill outlet from four inches of mercury to one half inch of mercury and the pressure at the gas discharge outlet of the separator from three inches of mercury to minus one half inch of mercury.

While it is preferable to apply the vacuum to the separator outlet as shown, the effect of the vacuum on the mill and on the separator are independent. For example, the vacuum could be applied to the mill alone, as for example, by placing a steam jet in the conduit 17 between the mill 11 and the cyclone separator 18. This would improve the mill operation in the manner described but would leave the cyclone separator operation unchanged.

The application of the vacuum also results in a substantial saving of steam. Without the vacuum, steam was normally introduced into the pipe 13 at a pressure of 100 p. s. i. and steam was injected into the pipe 15 at a pressure of 90 to 95 p. s. i. When the mill outlet pressure was reduced from four inches of mercury to one half inch of mercury, it was possible to reduce the inlet pressure at pipe 15 to 70 to 75 p. s. i. The saving in steam consumption substantially exceeds the cost of producing the vacuum.

Control of the vacuum, as for example, by varying

3

the speed of the motor 23 in any convenient manner, controls the through-put speed of the material, a higher vacuum giving a higher speed. Variation of the vacuum also causes variations in particle velocity in the mill which in turn varies the grinding speed and efficiency and the retention time in the mill. Increased particle velocity in the mill also results in smaller particles of more nearly uniform size.

From the foregoing it is apparent that the objects of the invention have been attained and that a new method and apparatus for comminuting materials has been provided in which the materials are efficiently comminuted at high speed and in which the speed and efficiency of comminution may be conveniently varied. Various changes and modifications can of course be made without departing from the spirit of the invention or the scope of the appended claims.

What is claimed and desired to be secured by United States Letters Patent is:

1. In apparatus for comminuting and classifying material; a fluid energy mill comprising an endless hollow housing having a curved portion; a tangential inlet in said housing; means for introducing a stream of gas under high pressure into said housing through said inlet at high velocity; means for introducing the material into said stream adjacent said inlet; an outlet connected to the inner periphery of said housing; a separator having an inlet; a material outlet and a gas outlet; means for preventing the entrance of air through the material outlet; means connecting the outlet of said mill with the inlet of said separator, and means for increasing the velocity of the gas through the mill and separator comprising vacuum means connected to the gas outlet of said separator for

4

reducing the pressure at the separator gas outlet below atmospheric pressure.

2. In apparatus for comminuting material, a housing defining an endless path having a curved portion, an inlet in said housing, means for introducing a stream of gas under high pressure and at high velocity at said inlet and directing said stream along said path, means for introducing the material to be comminuted into said stream of gas, an outlet in said housing located adjacent the curved portion of said path through which gas and material are removed from said housing, a material collector having a gas and material inlet and a gas outlet, means operatively connecting the collector inlet to the outlet of said housing and vacuum means operatively connected to the collector gas outlet for reducing the pressure at said collector gas outlet below atmospheric pressure.

References Cited in the file of this patent

UNITED STATES PATENTS

1,392,656	Rew	Oct. 4, 1921
2,474,314	Koehne	June 28, 1949

FOREIGN PATENTS

546,088	Great Britain	June 26, 1942
591,921	Great Britain	Sept. 2, 1947

OTHER REFERENCES

Chemical Engineers Handbook by J. H. Perry, third edition, pp. 1034 to 1039. (Copy in Div. 55.)
 Industrial & Engineering Chemistry, 1946, vol. 38, No. 7, page 677, column 2, 1st complete paragraph. (Copy in Pat. Off. Library.)