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R. P. PIPEROUX ET AL

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MOVING-FLUID-STREAM PULVERIZING APPARATUS WITH SCREENED DISCHARGE

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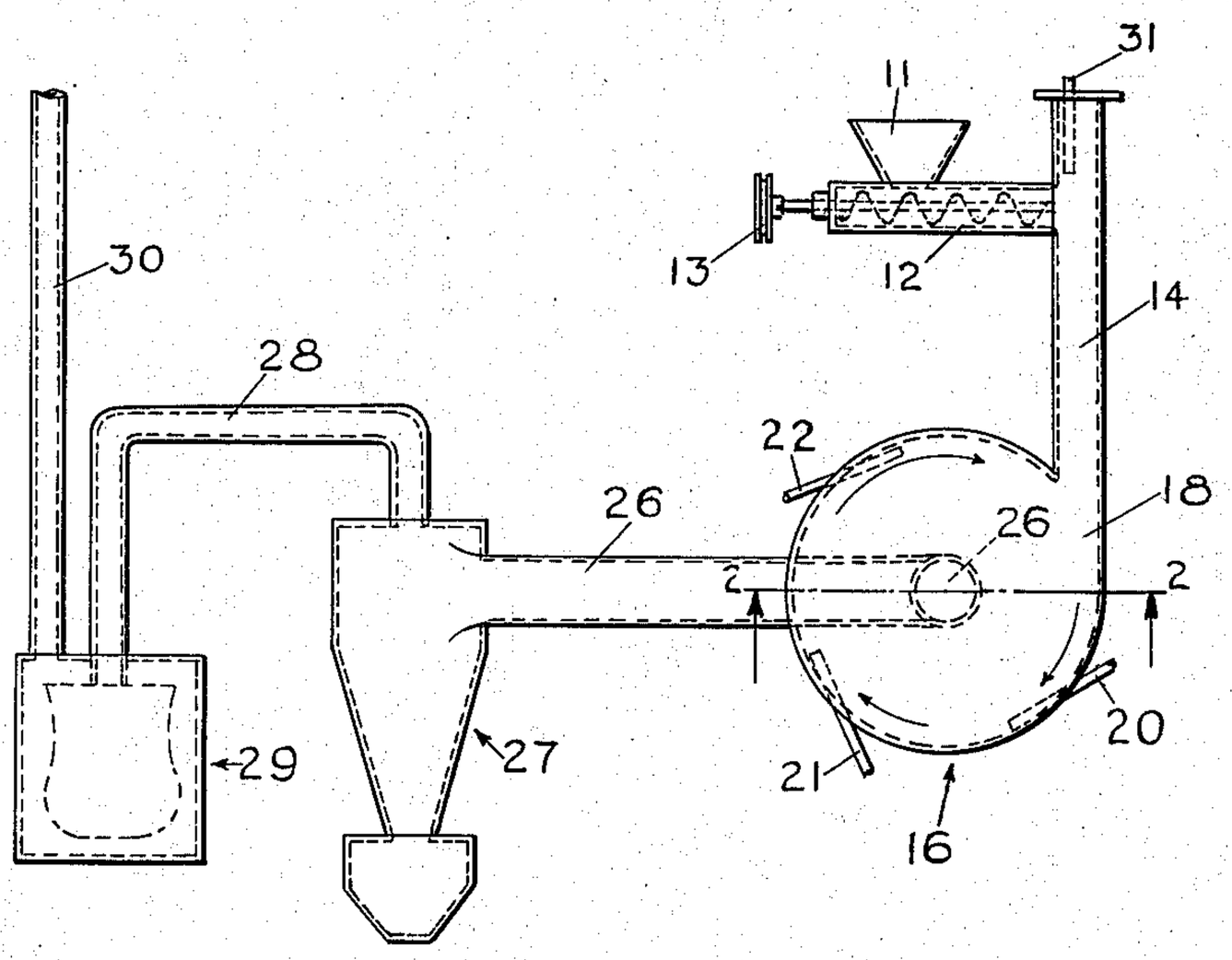

Fig. 1

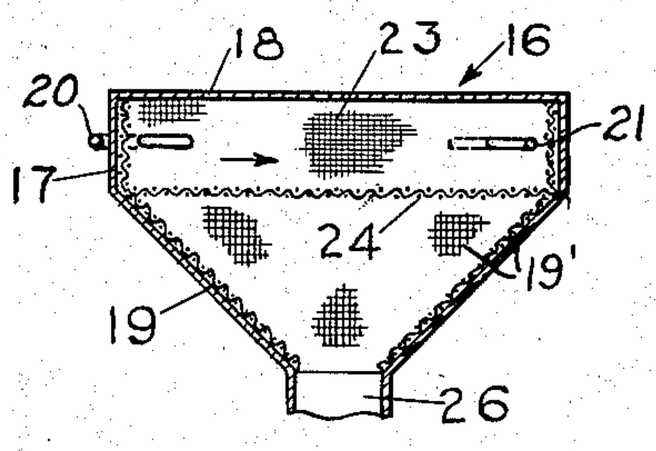

Fig. 2

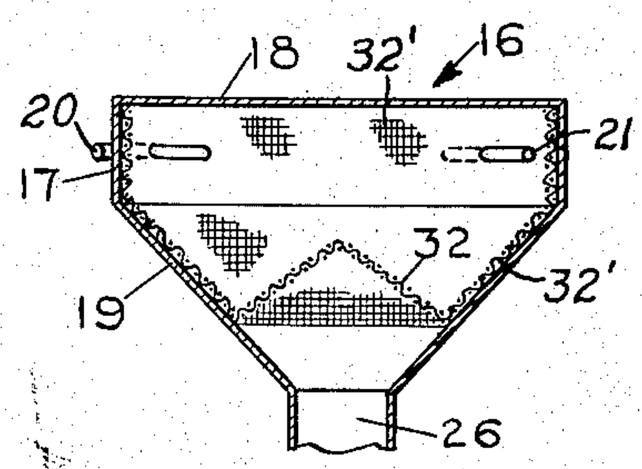

Fig. 3

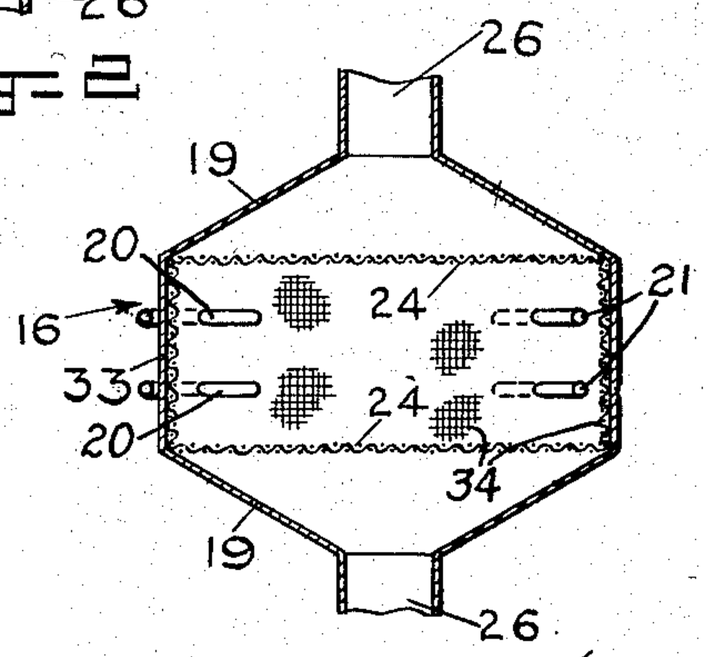

Fig. 4

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MOVING-FLUID-STREAM PULVERIZING APPARATUS WITH SCREENED DISCHARGE

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4 Claims. (Cl. 241—39)

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This invention relates to pulverizing apparatus, and relates more particularly to pulverizing apparatus in which pulverization is effected by means of a fluid.

As is well known, fluids are often employed for pulverizing material. Thus in the pulverization of materials which are porous and brittle, the materials may be permeated under pressure with a fluid having a high pressure-coefficient of expansion and thereafter, the materials passed to a low-pressure region wherein they are shattered by the fluid expansion caused by the drop in outside pressure. However, only a limited number of materials may be pulverized in this manner since those materials which are not porous will not be appreciably permeated by the fluid. Moreover, only gaseous fluids normally have a sufficiently high pressure-coefficient of expansion to be useful in carrying out this process. It is also possible to effect pulverization with a fluid, by suspending particles of a material in a rapidly moving stream of fluid, and pulverizing said material as a result of the impacts of the particles against each other and against the walls of the chamber in which they may be enclosed. While there are no limitations on the nature of the materials which may be pulverized in this manner, nor any limitations on the fluids which may be employed in this process, it has not come into widespread use. This is due to the fact that the only type of apparatus hitherto proposed for carrying out this process have been complex in construction and inefficient in use.

It is an important object of this invention to provide a pulverizing apparatus of the type in which pulverization is effected by means of a rapidly moving stream of fluid, which will be simpler in construction and more efficient in use than pulverizing apparatus of this type hitherto employed.

A further object of this invention is to provide a pulzerizing apparatus of the type in which pulverization is effected by means of a rapidly moving stream of fluid, in which the pulverized particles will be removed from the pulverizing zone as soon as they have been reduced to the proper size.

Another object of this invention is to provide a pulverizing apparatus of the type in which pulverization is effected by means of a rapidly moving stream of fluid, in which larger particles of material will concentrate at a point where they will be subjected to the maximum pulverizing effect.

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A still further object of this invention is to provide a pulverizing apparatus of the type in which pulverization is effected by means of a rapidly moving stream of fluid, which will screen the pulverized particles and thereby eliminate the necessity for auxiliary screening units.

Yet another object of this invention is to provide a pulverizing apparatus of the type in which pulverization is effected by means of a rapidly moving stream of fluid, which will be low in initial cost and have small space requirements.

Other objects of this invention, together with certain details of construction and combinations of parts, will be apparent from the following detailed description and claims.

In its broadest aspect, our invention comprises a pulverizing apparatus of the type employing a rapidly moving stream of fluid to effect pulverization, in which the pulverizing chamber includes a portion having a tapered cross-section. A rotary motion is imparted to a fluid in this chamber to effect the desired pulverization of a material therein, and the fluid is caused to pass from the wider to the narrower portion of the chamber whereby its velocity increases in inverse proportion to the decrease in the cross-sectional area of the chamber. The pulverized particles are carried through and from the pulverizing chamber by means of this fluid stream, and the increase in the velocity thereof prevents any particles from settling out of the fluid stream and accumulating in the pulverizing chamber. Moreover, the tapered cross-section insures a smooth flow of fluid through the pulverizing chamber without excessive turbulence.

Our invention also comprises a pulverizing apparatus of the type employing a rapidly moving stream of fluid to effect pulverization, in which a screening means is incorporated into the pulverizing chamber to positively retain the material being pulverized in the pulverizing section of the chamber until it has reached the desired size. This permits higher fluid velocities to be employed than where the sizing of the particles is effected by the fluid stream itself and also permits more freedom in the arrangement and placing of the pulverizing chamber.

A preferred embodiment of our invention is illustrated in the accompanying drawings in which

Figure 1 is a side elevational view of the pulverizing apparatus of this invention,

Figure 2 is a cross-sectional view of the pulverizing chamber taken on line 2—2 in Figure 1 in the direction of the arrows,

Figure 3 is a cross-sectional view of a pulverizing chamber of modified construction, and

Figure 4 is a cross-sectional view of another pulverizing chamber of modified construction.

Referring now to the drawing for a detailed description of this invention, the material to be pulverized is supplied to a hopper 11 from which it flows by gravity to a feed screw 12. The feed screw is driven by means of a pulley 13 rotated by any suitable means (not shown), and moves the material to be pulverized to a vertical feed pipe 14.

The material passes from feed pipe 14 to a pulverizing chamber, indicated generally by reference numeral 16, which comprises a base section 17 having one face closed by a wall 18, and having a tapered section 19 connected to the other face thereof. A rotary motion is imparted to the material entering the base section by means of streams of fluid issuing from the non-radially disposed jets 20, 21 and 22, which fluid is supplied to said jets from a suitable source (not shown). This rotary motion causes the rapid pulverization of the material in the pulverizing chamber by the impact of the particles of material against each other and against the walls of the chamber which may also be provided with a wire mesh lining 19'' to increase the efficiency of pulverization. To increase the efficiency of pulverization the inner surface of the pulverizing chamber may be roughened in any suitable manner such as by a wire mesh lining 23 or by corrugations on said surface. While the number and spacing of the jets 20, 21 and 22 is not critical, it is desirable that at least one of the jets such as jet 20 be directed toward the lowest portion of the base section 17 where any large particles of material in the chamber will tend to accumulate. In this manner such large particles will be rapidly disintegrated under the repeated impact of the particles suspended in the stream of fluid impinging thereon from said jet.

From the base section 17, the stream of fluid carries the pulverized particles through a screen 24 into the tapered section 19. By employing a screen 24 having a suitable mesh size, it is possible to insure that the pulverized particles have attained the desired degree of fineness before they leave the base section 17 where the major portion of the pulverization occurs. As the stream of fluid passes through the tapered section 19, its velocity will increase in proportion to the reduction in cross-sectional area, thereby preventing any pulverized particles that have passed through the screen 24 from settling out of the fluid stream and accumulating in the tapered section 19. The fluid stream with the pulverized particles suspended therein then passes through a pipe 26 to a conventional cyclone separator, indicated generally by reference numeral 27, wherein the pulverized particles settle out. The fluid stream then leaves the cyclone separator by means of a pipe 28 and passes through a conventional bag filter, indicated generally by reference numeral 29, to remove any dust particles. The fluid stream may then be exhausted from the bag filter through a pipe 30.

During normal operation the material being fed into the pulverizing apparatus will seal the passageway through the feed screw 12 to the hopper 11 and there will be very little tendency for the fluid to flow back from the pulverizing chamber through the feed pipe 14. However, when coarse materials, say, above about 16 mesh, are being fed there may be some tendency for the fluid to flow back through the interstices between the individual particles. To eliminate any such backflow of fluid from the pulverizing chamber, a jet 31 is provided at the top of the feed pipe 14 and a downstream of fluid created in said feed pipe by introducing a fluid into said jet.

In Figure 3 there is shown a pulverizing chamber of somewhat modified construction in which the screen 24 is replaced by a screen 32 positioned in the tapered section 19. By moving the screen to this position, pulverization will take place not only in the base section 17, but also in a portion of the tapered section 19 thereby increasing the total pulverizing surface. Moreover, with the screen in this position the particles being pulverized will segregate in zones according to size, with the largest particles in the base section and the fine particles in the tapered section. This segregation will tend to increase the efficiency of pulverization since it will eliminate the cushioning action which occurs when there is a mixture of particles of different sizes. Furthermore, since the velocity of the fluid stream increases along the tapered section 19, there will be a greater pulverizing effect on the particles as they pass along this section. To increase the efficiency of pulverization, the inner surface of both the base section 17 and the tapered section 19 up to the screen 32 may be roughened, as by covering the inner wall of said tapered section with a wire mesh lining 32', if desired.

In Figure 4 there is shown a pulverizing chamber modified in such a manner as to have a greatly increased throughput capacity. In this modification, the base section 17 is replaced by a wider base section 33. By employing twice as many jets around the periphery of the base section and removing the pulverized particles from both sides of the base section it is possible to increase the total grinding capacity of the apparatus to approximately twice its original capacity. As in the other pulverizing chamber, the inner surface of the base section 33 may be roughened in any suitable manner, as by covering the same with a wire mesh lining 34, if desired.

Any liquid or gaseous fluid may be employed to effect the pulverization and in most cases air is a preferred fluid since it is the least expensive. However, other gaseous fluids such as nitrogen, carbon dioxide, etc. may be substituted for air when the material being pulverized is sensitive to oxidation. If such a substitution is made, it is preferred to recirculate the fluid through the apparatus instead of discarding it after one pass as is generally the practice with air. Wet grinding may also be carried out by employing a liquid rather than a gaseous fluid.

When the material being pulverized is of a fibrous nature, the individual fibers often tend to mat on the surface of the screen and thereby obstruct the passage of the fluid therethrough. In the event that such matting occurs, it is preferred to remove the screen from the pulverizing chamber and rely on the stream of fluid to classify the pulverized particles as to size. By suitably controlling the fluid velocity, it is possible to have only those particles which have been reduced to the proper size removed from the base section, leaving the larger particles to undergo further pulverization. With the screens removed it may, however, be necessary to employ a separate screening means, returning the oversize particles to the pulverizing chamber in a manner well understood in the art.

It is to be understood that the foregoing detailed description is given merely by way of illustration and that many variations may be made therein without departing from the spirit of our invention.

Having described our invention, what we desire to secure by Letters Patent is:

1. In an apparatus for pulverizing material, a chamber having a plurality of pulverizing sections comprising a cylindrical section having a closure at one end and an opening at the opposite end and a tapered section connected to said cylindrical section coaxially thereto at said opening, said tapered section having an opening in the base thereof coinciding with said opening in said cylindrical section, means extending tangentially through the wall of said cylindrical section for supplying material to be pulverized to said cylindrical section, a plurality of jets extending through the wall of said cylindrical section for injecting fluid into said cylindrical section for imparting a rotary motion to the material therein to pulverize said material and to move said pulverized material through said tapered section, and screening means between said cylindrical section and said tapered section and extending completely across the opening between said sections, the construction and arrangement being such that the fluid passing through said tapered section attains an increased velocity whereby any material suspended in said fluid is prevented from settling therefrom and is subjected to further pulverizing action in said tapered section.

2. Apparatus in accordance with claim 1 wherein the cylindrical section and the tapered section have roughened inner surfaces.

3. In an apparatus for pulverizing material, a chamber having a plurality of pulverizing sections comprising a cylindrical section having a closure at one end and an opening at the opposite end and a tapered section connected to said cylindrical section coaxially thereto at said opening, said tapered section having an opening in the base thereof coinciding with said opening in said cylindrical section, material feed means, including a pipe, extending tangentially through the wall of said cylindrical section and means for injecting fluid into said pipe, for supplying material to be pulverized to said cylindrical section, a plurality of jets extending substantially tangentially through the wall of said cylindrical section for injecting fluid into said cylindrical section for imparting a rotary motion to the material therein to pulverize said material and to move said pulverized material through said tapered section, and screening means between said cylindrical section and said tapered section and extending completely across the opening between said sections, the construction and arrangement being such that the fluid passing through said tapered section attains an increased velocity whereby any material suspended in said fluid is prevented from settling therefrom and is subjected to further pulverizing action in said tapered section.

4. Apparatus in accordance with claim 3 wherein the cylindrical section and the tapered section have roughened inner surfaces.

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