July 6, 1926. 1,591,941

R. C. NEWHOUSE

COMMINUTING MILL

Filed June 9, 1921 2 Sheets-Sheet 1

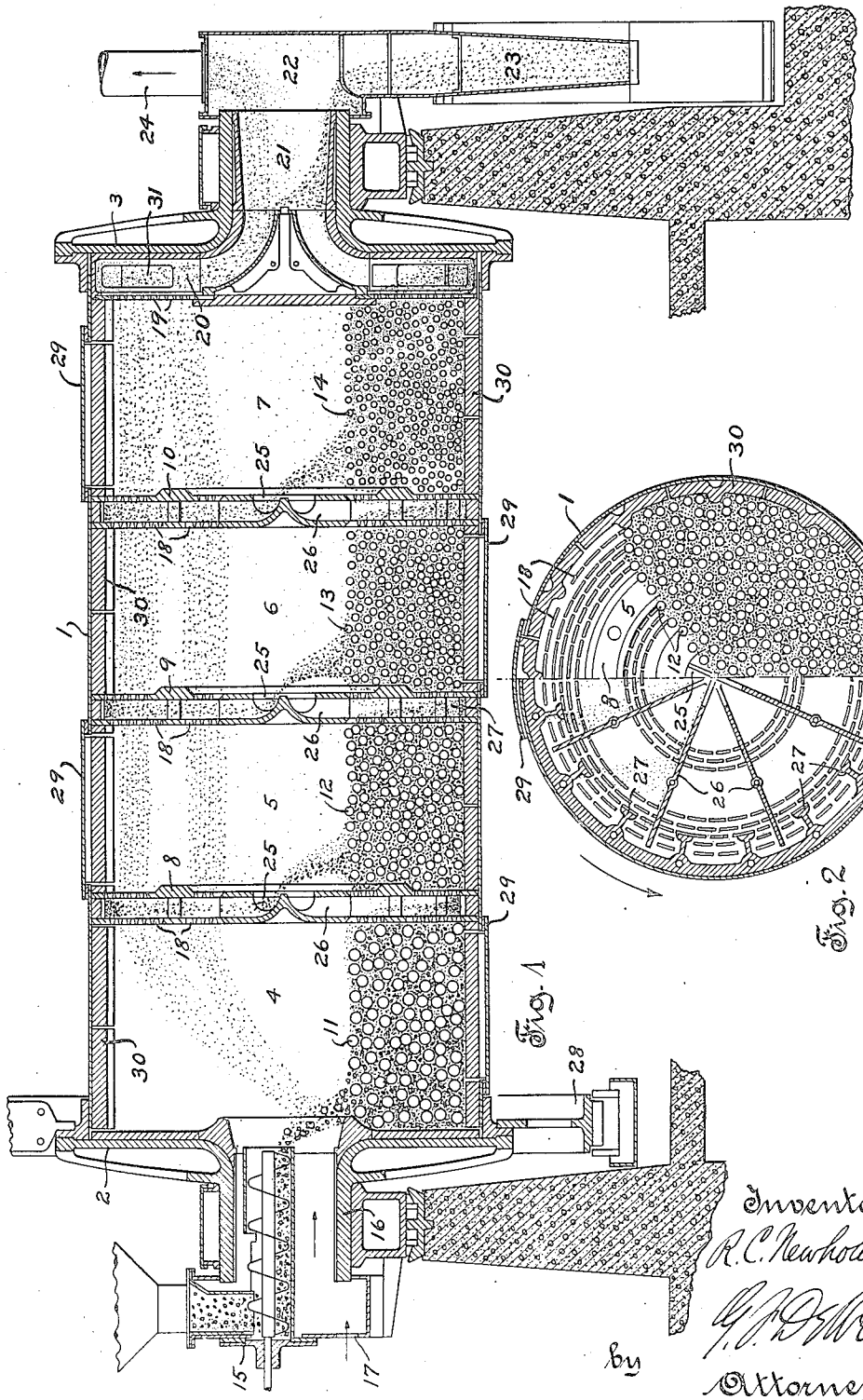


Fig. 1

Fig. 2

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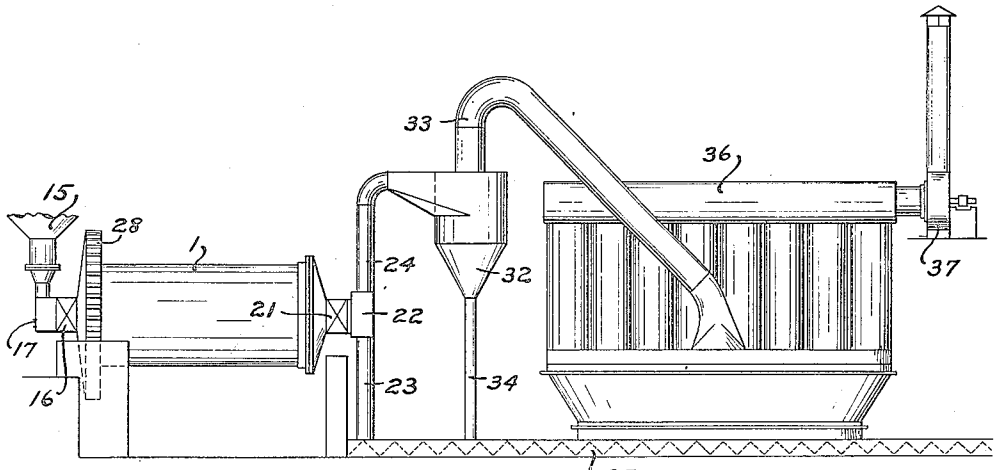


Fig. 3

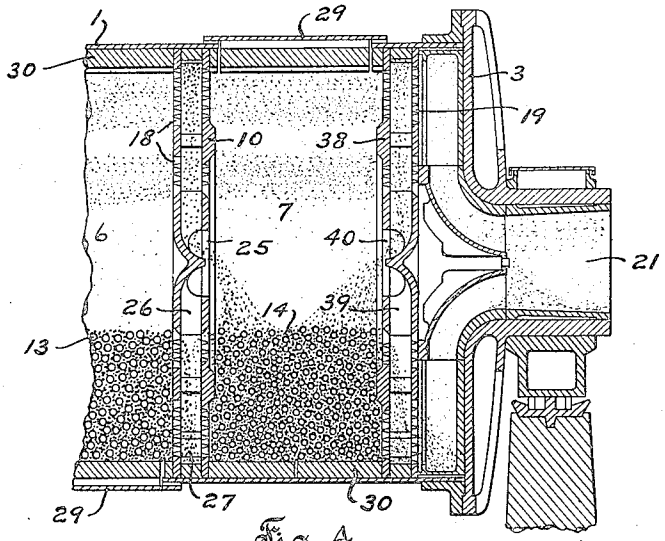


Fig. 4

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UNITED STATES PATENT OFFICE.

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COMMINUTING MILL.

Application filed June 9, 1921. Serial No. 476,136.

This invention relates in general to improvements in the art of reducing solid substances of various kinds by impact and abrasion, and relates more specifically to improvements in the construction and operation of rotary comminuting mills for disintegrating materials with the aid of a plurality of freely cascading bodies.

An object of the invention is to provide a comminuting mill which is simple in construction and efficient in operation. Another object of the invention is to provide efficient means for removing reduced material from a comminuting mill.

It has been discovered in operating rotary comminuting mills of the type which utilize freely tumbling comminuting bodies as a pulverizing medium, that considerable available energy is wasted due to the cushioning of the cascading bodies, by the material which is in pulverulent condition. This fine material lodges upon the comminuting bodies and packs in the voids between these bodies and around the larger particles of material which require further reduction, thereby preventing the tumbling comminuting bodies from effectively pulverizing the larger particles in the charge, and also preventing free delivery of the comminuted material from the charge.

In order to avoid such undesirable cushioning of the comminuting bodies, and also in order to enhance the capacity of mills of this type, the present invention contemplates rapid removal of the sufficiently comminuted material. With the present invention the fine particles of the material are removed from various places along the length of a mill, pneumatically, that is with the aid of a blast of air or other elastic fluid. The pneumatic removal of the material is made more effective by the provision of chambers which are free from comminuting bodies, and through which the material passing from one stage of the mill to another is showered. The capacity of a mill constructed in accordance with the present invention is further enhanced by the provision of mechanical means in addition to the pneumatic means, for removing material from the mill. While the mill illustrated herein and embodying the present invention is especially adapted for the reduction of fuel such as coal, it is not desired to limit the invention to such application.

Some of the novel features of comminuting mill construction herein shown and described but not specifically claimed, form the subject of copending application S. N. 188,258, filed August 23, 1917.

A clear conception of several embodiments of the present invention and of the operation of a mill constructed in accordance therewith, may be had by referring to the drawings accompanying and forming a part of this specification, in which like reference characters designate the same or similar parts in the various views.

Fig. 1 is a central vertical section through a multi-stage rotary comminuting mill embodying means for showering material between successive stages of the mill.

Fig. 2 is a transverse vertical section through the rotary multi-stage comminuting mill, part of the section being taken through one of the comminuting chambers and another part of the section being taken through one of the showering chambers.

Fig. 3 is a diagrammatic side elevation illustrating the application of the new comminuting mill in a powdered fuel distributing system.

Fig. 4 is a fragmentary central vertical section through another form of multi-stage rotary comminuting mill embodying features of the invention.

The combination or multi-stage comminuting mill disclosed in Figs. 1 and 2, comprises in general a rotary cylindrical casing 1 illustrated as having uniform diameter throughout its length, the casing being provided with feed and discharge end heads 2, 3 respectively, and having therein a series of partitions or division heads 8, 9, 10 which divide the casing 1 into successive stages or comminuting chambers 4, 5, 6, 7 respectively. The successive comminuting chambers 4, 5, 6, 7 have tumbling comminuting bodies 11, 12, 13, 14 of gradually decreasing sizes therein, the largest comminuting bodies 11 being located in the coarse grinding chamber 4 and the smallest comminuting bodies 14 being located in the finishing chamber 7. The mill is rotatably mounted in suitable end bearings which embrace the feed and discharge trunnions 16, 21 respectively. Rotary motion about its horizontal central axis is imparted to the mill, by means of power applied to a driving gear 28 associated with the feed end head 2. The interior of the several

comminuting chambers formed by the casing 1, is provided with liners 30 and each of the chambers 4, 5, 6, 7 is preferably provided with a removable cover 29 for permitting independent access to the interior of any one of the chambers of the mill. The feed end of the mill is provided with a mechanical feeder 15 for introducing the material which is to be reduced, into the inlet end of the coarse grinding chamber 4 through the feed trunnion. The feed end of the mill is also provided with suitable openings 17 which may be adjustable in size, for admitting air or other elastic fluid to the interior of the mill.

Each of the partitions or division heads 8, 9, 10 comprises a pair of parallel walls spaced apart to form an intermediate showering chamber which is free from comminuting bodies. Each of the walls of a division head is provided with a multiplicity of openings 18 which are of such size that they will permit material to freely enter and leave the showering chamber from and to the adjacent comminuiting chambers, but will not permit the comminuting bodies to enter the showering chamber. Within each of the showering chambers is located a plurality of radial conducting vanes 26 and a plurality of T shaped projections or precipitators 27 which during normal operation of the mill are adapted to elevate the material delivered into the lower portion of the showering chamber and to precipitate or shower this material downwardly through the showering chamber and upon the conducting vanes 26. The inner extremities of the conducting vanes 26 terminate adjacent to a central conducting cone the apex of which extends toward a discharge opening 25 in the division head.

The discharge end of the finishing chamber 7 of the mill disclosed in Fig. 1 is provided with a perforated plate 19 which is spaced from the end head 3. Located within the space between plate 19 and the end head 3 is a series of elevating vanes 20 each of which is provided with a relatively large opening the size of which is adjustable by means of a radially slidable adjusting plate 31. The inner extremities of the elevating plates 20 are located in proximity to a central final discharge cone the apex of which is directed toward the discharge trunnion 21.

The discharge end of the finishing chamber 7 of the mill disclosed in Fig. 4 is provided with a perforated division plate 38 spaced from the perforated plate 19 and forming a showering chamber 39 similar to the showering chambers in the division heads. The central portion of the plate 19 is provided with a return cone having its apex directed toward the finishing chamber 7 and surrounded by a central rejects return opening 40. The perforated plate 19 is spaced from the end head 3, the space between these elements being free from elevating vanes. The medial portion of this final discharge space or chamber is provided with a central discharge cone having its apex directed toward the discharge trunnion 21 as in the mill disclosed in Fig. 1.

In the diagram illustrating the application of the new comminuting mill in a powdered fuel distributing system, as shown in Fig. 3, the final discharge from the trunnion 21 is delivered into an initial separating chamber 22. From this initial separator the coarser particles of material are delivered by gravity through a discharge spout 23 into a horizontal conveyor 35. The finer particles of material are carried by the air blast through a discharge conduit 24 and are delivered into a cyclone separator 32. The relatively coarse material removed from the dust laden air by the separator 32 is delivered by gravity through a conduit or spout 34 into the conveyor 35, while the air which still contains considerable fine material, is delivered to a bag type of dust collector 36 through a conduit 33. The pure air is withdrawn from the final separator 36 by means of a suction fan 37, this fan serving to create the flow of air through the entire system. The fine particles of material removed by the dust collector 36 are delivered by gravity to the conveyor 35 where they mingle with the particles of material previously removed, and from which all of the material is delivered to the desired point of utilization.

During the normal operation of the mill disclosed in Figs. 1 and 2, the raw material is admitted to the coarse grinding chamber 4 by the feeder 15, the suction fan 37 having been first placed in operation and rotation having been imparted to the shell 1 by means of the gear 28. As the material falls into the mill, the sufficiently fine particles are immediately removed and are carried away by the blast of air entering through the opening 17. The remaining material which requires further reduction is initially reduced during its passage through the coarse grinding chamber 4 by the tumbling and rubbing action of the large comminuting bodies 11. At the discharge end of the chamber 4, material is delivered into the first showering chamber located within the division head 8. The material thus admitted to the first showering chamber is elevated by the precipitators 27 and during rotation of the mill, is showered toward the conducting vanes 26. The air blast passing through the chamber 4 enters the first showering chamber through the openings 18 and passes through the falling material delivered from the precipitators 27. During this transgression of the air blast the fine

particles of material are removed and are carried from the showering chamber through the perforations in the second wall of the division head 8. The relatively coarse particles of material drop through the air blast and upon the conducting vanes 26, and are delivered through the opening 25 into the second grinding chamber 5. Due to the passage of air through the relatively small perforations below the central opening 25, the delivery of material to the second comminuting chamber 5 is graded, that is, the coarser particles of material are deposited directly adjacent to the partition 8 while the finer particles are carried along the mill by the air blast and are delivered into the chamber 5 more remotely from the partition 8, thus admitting the particles to different portions of the chamber 5 in accordance with their relative sizes.

The coarser particles of material are further reduced while passing through the second comminuting chamber 5 by the tumbling and rubbing action of the comminuting bodies 12. At the discharge end of the chamber 5 material is delivered into the second showering chamber located within the division head 9. The material thus admitted to the second showering chamber is elevated by the precipitators 27 therein, and is showered as in the previous showering compartment. The air blast passing through the chambers 4 and 5 enters the second showering chamber through the openings 18 and passes through the falling material thereby removing the fine particles and carrying them from this showering chamber through the perforations in the discharge wall of the division head 9. The remaining relatively coarse particles of material drop through the air blast and upon the conducting vanes 26 and are delivered through the opening 25 into the third comminuting chamber 6. As in the case of the delivery to the preceding chamber 5, the admission of material to the third comminuting chamber 6 is again graded.

The remaining coarse particles of material are further reduced while passing through the third comminuting chamber 6 by the tumbling and rubbing action of the comminuting bodies 13. At the discharge end of the chamber 6 material is delivered into the third showering chamber located within the division head 10. The material thus admitted to the third showering chamber is elevated by the precipitators 27 therein, and is showered as in the preceding showering compartments. The air blast passing through the chambers 4, 5, and 6 enters the third showering chamber through the openings 18 and passes through the falling material thereby removing additional fine particles and carrying them from this showering chamber through the perforations in the discharge wall of the division head 10. The remaining relatively coarse particles of material drop through the air blast and upon the conducting vanes 26 and are delivered through the opening 25 into the fourth or finishing chamber 7. As in the case of the delivery to the preceding chambers 5 and 6, the admission of material to the finishing chamber is again graded.

In the finishing chamber 14 the material is finally comminuted by the tumbling and rubbing action of the comminuting bodies 14. The material is finally delivered from the finishing chamber 27 through the perforations in the plate 19 and is deposited into the path of the elevating vanes 20. These vanes elevate the finished product and eventually deposit the same upon the final discharge cone which conducts the material into the conduit 21 from which it is delivered into the separating chamber 22. In the separating chamber 22 the remaining relatively coarse particles are deposited by gravity through the spout 23 into the conveyor 35, while the air blast carries the finer product upwardly through the conduit 24 and delivers the same into the cyclone separator 32. The air delivered from the cyclone separator 32 which still contains an appreciable amount of material, is eventually passed through the final separator 36 wherein practically all of the solids are removed.

It will be noted that the air blast passing through the material delivered from the feeder 15 into the initial grinding compartment 4 will also to some extent, grade the delivery of material from the feeder 15 to the compartment 4. By thus grading the admission of material to the charges in the several grinding compartments 4, 5, 6, 7, the coarser particles are more efficiently reduced due to the absence of fine material from the portion of the charge to which they are admitted. The air blast passing through the mill also has a sweeping action upon the charges in the several compartments thereby enhancing the mill efficiently by removing the fine material which would otherwise tend to cushion the cascading comminuting bodies. This air blast will obviously become more and more saturated with fine material as it advances through the mill, and the amount of material which it is capable of removing will be dependent upon the velocity and volume of air contained in the blast.

The adjustable plate portions 31 of the elevating vanes 20 serve to permit retention and reduction of material within the mill for a longer period of time. In the mill disclosed in Fig. 4 the elevating vanes have been omitted entirely and the final showering compartment formed by the division wall 38, returns the over-size ma-

terial to the finishing chamber 7 thereby positively insuring complete reduction of all of the material. With the mill disclosed in Fig. 1, the discharge product will undoubtedly contain some relatively large particles but such over-size material is not objectionable when reducing coal and other fuel adapted for use in powdered fuel heating installations.

It will be obvious that a mill constructed in accordance with this invention will to a large extent, avoid undesirable cushioning of the comminuting bodies and will have relatively great capacity due to removal of fine material at various points along the mill. The pneumatic removal affords a simple and efficient method of removing and of subsequently conveying the material from the mill. The showering chambers which are free from comminuting bodies enable the air blast to effectively remove the fine particles and also provide simple means for grading the delivery of material to the successive comminuting chambers. While the mill has been disclosed as embodying four separate comminuting chambers, it will be understood that this number may be increased or diminished in accordance with objects to be accomplished.

It should be understood that it is not desired to limit the invention to the exact details of construction and of operation herein shown and described, for various modifications within the scope of the claims may occur to persons skilled in the art.

It is claimed and desired to secure by Letters Patent:—

1. In combination, a rotary drum, walls dividing said drum into a series of chambers, the successive walls having perforations providing an annular series of substantially rectilineal passages extending throughout the length of said drum, comminuting bodies located only in alternate chambers of said series, means for causing a blast of gas to flow through said passages, and means for showering material through said blast within said intermediate chambers.

2. In combination, a drum rotatable about an axis and having uniform diameter throughout its length, parallel walls dividing said drum into a series of chambers, the successive walls having perforations providing an annular series of substantially rectilineal unobstructed passages extending parallel to said axis and throughout the length of said drum, comminuting bodies of graded size located only in alternate chambers of said series, means for causing a blast of gas to flow through said passages, and precipitators for showering material through said blast within said intermediate chambers.

3. In combination, a drum rotatable about a horizontal axis, transverse walls dividing said drum into a series of chambers, the successive walls having perforations providing unobstructed rectilineal passages extending parallel to said axis and throughout the length of said drum, comminuting bodies located only in alternate chambers of said series, means for causing a blast of gas to flow through said passages above the level of said bodies, and means for showering material through said blast within said intermediate chambers.

4. In combination, a drum rotatable about an axis, transverse walls dividing said drum into a series of chambers, all of said walls having perforations providing unobstructed rectilineal passages extending throughout the length of said drum, comminuting bodies located only in alternate chambers of said series, precipitators, for showering material through the intermediate chambers transversely of said passages, a separator for receiving material discharged from said drum, and common means for causing a blast of gas to flow through said passages and said separator in succession.

In testimony whereof, the signature of the inventor is affixed hereto.

RAY C. NEWHOUSE.