March 27, 1951 J. KLAGSBRUNN 2,546,860

CENTRIFUGAL MILL

Filed Feb. 25, 1948

FIG. 6.

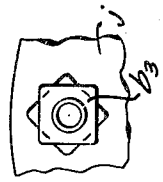


FIG. 8.

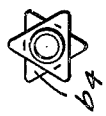


FIG. 5.

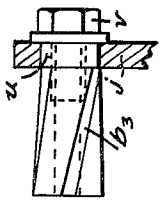


FIG. 7.



FIG. 10.

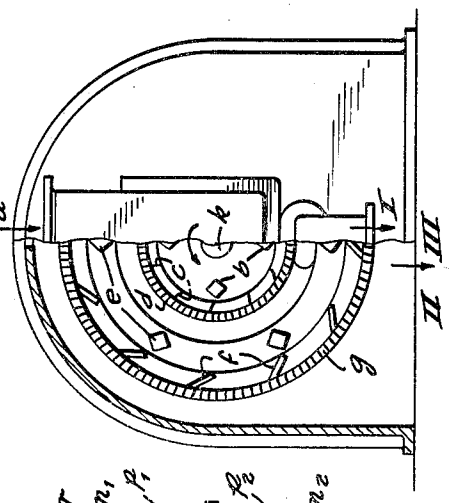


FIG. 4.

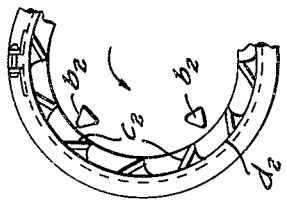


FIG. 3.

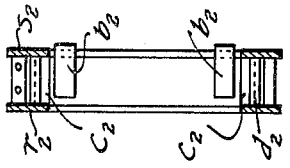


FIG. 9.

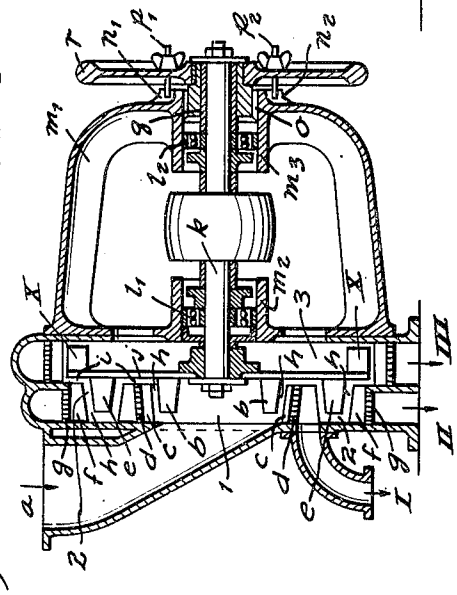


FIG. 2.

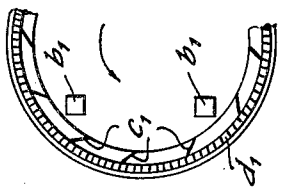
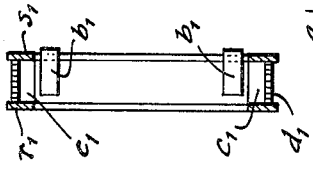


FIG. 1.



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CENTRIFUGAL MILL

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Section 1, Public Law 690, August 8, 1946
Patent expires September 5, 1959

6 Claims. (Cl. 241—74)

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This invention relates to centrifugal mills.

Centrifugal mills are known in which the material to be ground is introduced axially and is thrown against stationary grooved, toothed, or trough-like grinding rims by means of rapidly rotating centrifugal members and thus comminuted. In these and in similar centrifugal mills, the material to be ground, after undergoing one or more grinding stages, reaches a grid or sieve through which particles of the product of the desired size pass and leave the mill, while the residue rejected by the grid or sieve is thrown around and ground on the latter until it is likewise sufficiently comminuted and passes through. This constitutes a great disadvantage in centrifugal mills, since through such grinding on the grids or sieves heavy losses occur, whilst the output of the mill is decreased and the power consumption increased. Moreover, in consequence of the friction, the material may also be exposed to a detrimental heating when the latter is sensitive to heat, and when the material is combustible this may lead to the danger of fire.

The present invention aims at obviating the foregoing drawback by carrying out the grinding and sifting simultaneously but in separate parts of the apparatus, the material to be ground being thrown back by rebound surfaces on to the sieve or grid surfaces, whereupon the corresponding grain size is sifted off and the residue is diverted to another path. This not only eliminates the foregoing disadvantages, but also simplifies the design of the mill.

In order to enable the invention to be more readily understood, reference is made to the accompanying drawings which illustrate diagrammatically and by way of example various embodiments thereof, and in which:

Fig. 1 is an axial section of one form of mill drum made according to the invention; and

Fig. 2 a radial section of the same drum;

Figs. 3 and 4 are corresponding cross-sections of a second embodiment;

Figs. 5 and 6 are respectively a side and an end elevation of a centrifugal grinding tool;

Figs. 7 and 8 are corresponding views of another embodiment of centrifugal tool;

Figs. 9 and 10 are respectively a longitudinal section and a cross-section of a multi-stage form of the centrifugal mill.

In the figures, a denotes the inlet hopper of the mill, b the striking members or centrifugal grinding tools; c the rebound surface members, and d the grids or sieves.

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In the embodiment shown in Figs. 1 and 2, the rotor or drum with the centrifugal tools b, throws the material to be ground against the rebound surface members c_1, which are disposed between two rings r_1 and s_1 and surrounded on the outside by an annular grid d_1. The angle and shape of the rebound surfaces c_1 and of the centrifugal tools b_1 are so arranged that the material to be ground, which is comminuted and thrown back by the rebound surfaces, is thrown on to the grid, where the corresponding grain size passes through and leaves the mill through an aperture or apertures in grid d_1, while the residue being of too large grain size to pass through, is diverted on to another path, preferably axially of the mill.

Figs. 3 and 4 show another embodiment, in which the rebound surfaces c_2 are surrounded by a perforated ring d_2 serving as a sieve.

It is also possible to dispose the grid or sieve, for example, in the form of an annular segment of a circle to the side of the rebound surfaces, or otherwise near the latter, instead of around the rebound surfaces. In the case of lateral arrangements, s_1 in Fig. 1 would be the grid or sieve, while d_1 would be a solid bounding wall. The shape and angle of the rebound surfaces c_1 must then of course be so designed and radially disposed that the material rebounds in a lateral direction.

The residue rejected by the sieve, which is of too coarse a grain and therefore cannot pass through the sieve or grid, is passed out of the mill, or out of the stage of the mill, axially along another path, and for the purposes of further grinding can then either be returned to the same grinding stage or passed to another stage.

By using multi-stage mills in accordance with the invention, the particular advantage can be obtained that a different sifting stage can be allocated to each grinding stage, so that a plurality of products ground to different desired grain sizes can be produced by the same mill.

This arrangement affords a particular advantage, when grinding corn, where it is essential to separate the more easily ground grain from the more difficultly ground husk (bran) as well as when grinding all non-homogeneous materials containing more easily and more difficultly grindable components, i. e. both natural products (wood, straw, stalks, fodder, asbestos, bristles, feathers), and also synthetic or waste products (such as felt, paper, leather or rags), when it is important to grind the solid components and to separate the unground fibrous parts. The fibers or residue remaining upon the sieve which

is of too coarse a grain and therefore cannot pass through the sieve so as to be ground is passed out of this stage of the mill along another path to the next grinding stage.

Of course, the proper design of the centrifugal tools or members definitely contributes to the effective operation of the apparatus as a whole.

In this connection, several forms of construction or design of centrifugal tools or grinding members are illustrated in Figs. 5 to 8. In these forms of construction thus shown, the centrifugal tools have a helical pitch which introduces two desirable advantages. Primarily, the result is that the mill operates more smoothly because the striking surfaces of the centrifugal members do not operate along their entire lengths at the same moment, so that sudden jolts are avoided; in the second place the centrifugal tool acts to a certain extent as a conveyor screw, which considerably accelerates the axial delivery of the material to be ground. Figs. 5 and 6 illustrate a four-edged centrifugal tool, while Figs. 7 and 8 show a centrifugal tool having a three-edged profile.

In order to achieve the effect of softening impact, the rebound surface may be twisted instead of the centrifugal tools, or both the rebound surface and the centrifugal tool may be twisted. Another possible way of achieving this effect is to design the striking surfaces *b* and or the rebound surfaces *c* in the form of steps, the effect of which is also that the material to be ground does not impinge at the same time on the entire length of the striking or rebound surfaces, but successively on the various parts of the length.

A further improvement can be achieved by making the mutual angle of the striking and rebound surfaces *b* and *c*, which decides the direction of the rebound of the material ground, adjustable.

This can be effected, for example, by rotatably fixing the centrifugal bodies in the rotor, as is illustrated in Figs. 5 and 6. The rotor is designated by *j*, and in it the centrifugal body b_3 is rotatably secured. After loosening the screw *v*, the body can be adjusted as desired by the round neck *u*.

In order to adjust the mutual angle of the striking and rebound surfaces, the rebound surfaces can naturally be made adjustable instead of the striking surfaces, or they can both be adjustable.

If it is desired to grind material which is tough or difficult to grind, it is advantageous to provide one or more pre-grinding stages, which comminute the material to some extent before it reaches the grinding stage with the simultaneous sifting, ahead of the sifting and grinding stage or stages. In these preliminary stages the adjustability of the mutual angle of the striking and rebound surfaces is particularly important. For since the direction of rebound of the material ground can be influenced by the angle of inclination of the striking and rebound surfaces, the adjustment enables the material to be ground, to be left a shorter or longer time in the grinding stage in question and therefore to be ground to a greater or less extent.

Figs. 9 and 10 illustrate a further embodiment of the invention, namely a three-stage mill. Each of the three grinding stages 1, 2 and 3 of said mill is equipped with an outlet I, II and III for the ground product. The material to be ground passes at *a* through the hopper into the mill, and then into the first grinding stage 1, where it is thrown by the strikers *b* secured to the rotor *j* against the rebound surfaces *c*, comminuted and sifted by the grid *d*. The material which passes through the grid leaves the mill at I, while the residue passes into the second grinding stage 2 comprising the strikers *e*, rebound surfaces *f*, the grid *g*, where the process is repeated, and likewise also in the third stage.

If the mill is not intended to supply at the same time different grain sizes, but only one ground product of a predetermined degree of fineness, this can be achieved by the provision of identical sieves in all grinding stages.

Figs. 9 and 10 show an advantageous device for the simultaneous regulation both of the distance between the striking surfaces and the rebound surfaces, and of the width of the cross-sectional passage from one grinding stage to the next, even during operation, in order to accelerate or to retard the grinding process in accordance with the grinding work of the material. To this end, both the rebound surfaces and the striking surfaces are sloped, so that when they are horizontally adjusted relatively to one another, the distance between them in the vertical direction is also altered. At the same time the passage cross-sections for the residues rejected by the sieves from one grinding stage to the next, which are formed by the outer walls of the rebound surface rings and the vertical rotor wall, are also enlarged or reduced. This is effected by displacement of the rotor secured to the shaft in the axial direction. In addition, further blades or strikers X are mounted on the rotor on the side opposite to that carrying strikers *e*, being disposed at a greater radial distance from the rotor axis than these strikers and adding their further contrifugal grinding effect to the operation of the mill as a further step of operation in the latter.

In Fig. 9, *h* denotes the distance between the sloping surfaces, and *i* the passage cross-section. The distance *h* and the passage cross-section *i* are regulated by axial displacement of the rotor *j*. The mill shaft *k* runs in the ball bearings l_1 and l_2.

The bearings are disposed in the two bearing bushes m_2 and m_3, which are connected by the shield m_1. The bush m_3 is provided with an internal thread *o*, into which the sleeve *q* is screwed by means of the hand-wheel *r*. In order to secure the hand-wheel, screws p_1 and p_2 are provided, which can be swung out around the bolts n_1 and n_2. By turning the hand-wheel, the shaft is moved in the axial direction and thereby regulates both the distance between the striking and rebound surfaces, and the passage aperture for the residue rejected by the sieve.

The invention is obviously not restricted to the embodiments described, but can be carried out in other ways, namely by carrying out the grinding and sifting simultaneously in the same grinding stages, but with the aid of separate members. In addition to the aforementioned economic and technical advantages, the advantage is thus obtained that especially in the case of rough and coarse grinding, the desired ground product is obtained with suitable grain size and with considerable elimination of powdering. The arrangement of the present invention has been found particularly convenient not only for the grinding of corn and the like, but also for industrial grinding.

What I claim is:

1. A high speed centrifugal mill, comprising

a mill housing having an end wall with a central opening; a hopper mounted upon the end wall and leading to the central opening; an annular sieve grating fixed upon the wall and extending axially inward into the housing; a series of rebound members rigidly spaced apart upon the interior of the sieve grating and inclined with respect to the periphery of the latter, the housing having a discharge opening for ground material sifted through said sieve grating located externally of the latter; a driven rotor rotatably mounted in said housing and spaced a predetermined axial distance from the end wall of the latter and having a series of grinding tools mounted thereon which extend toward said end wall in effective position to rotate with said rotor past said rebound means during operation; a second annular sieve grating fixed upon said end wall in concentric relation to and spaced a distance exteriorly of the first annular sieve grating; a second series of rebound members rigidly spaced apart upon the interior of said second sieve grating and inclined to the periphery of the latter; a second series of grinding tools mounted on said rotor and extending toward said end wall intermediate the two annular sieve gratings; passage means for leading off from the mill the ground and sifted material passing through the second annular sieve grating; and a portion in said housing of greater diameter than that of said second sieve grating for receiving the coarse grain material rejected from said second sieve grating externally of the periphery of said rotor.

2. A high speed centrifugal mill, comprising a mill housing having an end wall with a central opening; a hopper mounted upon the end wall and leading to the central opening; an annular sieve grating fixed upon the wall and extending axially inward into the housing; a series of rebound members rigidly spaced apart upon the interior of the sieve grating and inclined with respect to the periphery of the latter, the housing having a discharge opening for ground material sifted through said sieve grating located externally of the latter; a driven rotor rotatably mounted in said housing and spaced a predetermined axial distance from the end wall of the latter and having a series of grinding tools mounted thereon which extend toward said end wall in effective position to rotate with said rotor past said rebound means during operation; a second annular sieve grating fixed upon said end wall in concentric relation to and spaced a distance exteriorly of the first annular sieve grating; a second series of rebound members rigidly spaced apart upon the interior of said second sieve grating and inclined to the periphery of the latter; a second series of grinding tools mounted on said rotor and extending toward said end wall intermediate the two annular sieve gratings, the mill housing having an enclosed annular passage peripherally encircling the second sieve grating and having a delivery opening for delivering the ground material sifted through the latter grating; and a portion in said housing of greater diameter than that of said second sieve grating for receiving the coarse grain material rejected from said second sieve grating externally of the periphery of said rotor.

3. A high speed centrifugal mill, comprising a mill housing having an end wall with a central opening; a hopper mounted upon the end wall and leading to the central opening; an annular sieve grating fixed upon the wall and extending axially inward into the housing; a series of rebound members rigidly spaced apart upon the interior of the sieve grating and inclined with respect to the periphery of the latter, the housing having a discharge opening for ground material sifted through said sieve grating located externally of the latter; a driven rotor rotatably mounted in said housing and spaced a predetermined axial distance from the end wall of the latter and having a series of grinding tools mounted thereon which extend toward said end wall in effective position to rotate with said rotor past said rebound means during operation; a second annular sieve grating fixed upon said end wall in concentric relation to and spaced a distance exteriorly of the first annular sieve grating; a second series of rebound members rigidly spaced apart upon the interior of said second sieve grating and inclined to the periphery of the latter; a second series of grinding tools mounted on said rotor and extending toward said end wall intermediate the two annular sieve gratings, the mill housing having an enclosed annular passage peripherally encircling the second sieve grating and having a delivery opening for delivering the ground material sifted through the latter grating; a third annular sieve grating of greater diameter than that of said second sieve grating extending axially inward in said housing from the inner side wall of the enclosed annular passage and peripherally exteriorly of the rotor for receiving the material of too coarse grain size to pass through said second sieve grating when moved axially inward from the latter; a second enclosed annular passage perhipherally encircling said third annular sieve grating and having a delivery opening for delivering material ground and sifted through said third annular sieve grating; and a series of further members upon the rotor extending axially inward from the side thereof remote from said end wall and disposed at greater radial distances from the center of said rotor than the grinding tools of said second series.

4. A high speed centrifugal mill, comprising a mill housing having an end wall with a central opening; a hopper mounted upon the end wall and leading to the central opening; an annular sieve grating fixed upon the wall and extending axially inward into the housing; a series of rebound members rigidly spaced apart upon the interior of the sieve grating and inclined with respect to the periphery of the latter, the housing having a discharge opening for ground material sifted through said sieve grating located externally of the latter; a driven rotor rotatably mounted in said housing and spaced a predetermined axial distance from the end wall of the latter and having a series of grinding tools mounted thereon which extend toward said end wall in effective position to rotate with said rotor past said rebound means during operation; a second annular sieve grating fixed upon said end wall in concentric relation to and spaced a distance exteriorly of the first annular sieve grating; a second series of rebound members rigidly spaced apart upon the interior of said second sieve grating and inclined to the periphery of the latter; a second series of grinding tools mounted on said rotor and extending toward said end wall intermediate the two annular sieve gratings, the mill housing having an enclosed annular passage peripherally encircling the second sieve grating and having a delivery opening for delivering the ground material sifted through the latter grating; a third annular sieve grating of greater diameter than that of said second sieve grating extending axially inward in said housing from the inner side wall of the enclosed annular passage and peripherally exteriorly of the rotor for receiving the material of too coarse grain size to pass through said second sieve grating when moved axially inward from the latter; a second enclosed annular passage perhipherally encircling said third annular sieve grating and having a delivery opening for delivering material ground and sifted through said third annular sieve grating; and a series of further members upon the rotor extending axially inward from the side thereof remote from said end wall and disposed at greater radial distances from the center of said rotor than the grinding tools of said second series.

4. A high speed centrifugal mill, comprising a mill housing having an end wall with a central opening; a hopper mounted upon the end wall and leading to the central opening; an annular sieve grating fixed upon the wall and extending axially inward into the housing; a series of rebound members rigidly spaced apart upon the interior of the sieve grating and inclined with respect to the periphery of the latter, the housing having a discharge opening for ground material sifted through said sieve grating located externally of the latter; a driven rotor rotatably mounted in said housing and spaced a predetermined axial distance from the end wall of the latter and having a series of grinding tools mounted thereon which extend toward said end wall in effective position to rotate with said rotor past said rebound means during operation; a second annular sieve grating fixed upon said end wall in concentric relation to and spaced a distance exteriorly of the first annular sieve grating; a second series of rebound members rigidly spaced apart upon the interior of said second sieve grating and inclined to the periphery of the latter; a second series of grinding tools mounted on said rotor and extending toward said end wall intermediate the two annular sieve gratings, the transverse section of each grinding tool of both series forming an angular geometrical figure and longitudinally having a torsional pitch from end to end; passage means for leading off from the mill the ground and sifted material passing through the second annular sieve grat-

ing; and a portion in said housing of greater diameter than that of said second sieve grating for receiving the coarse grain material rejected from said second sieve grating externally of the periphery of said rotor.

5. A high speed centrifugal mill, comprising a mill housing having an end wall with a central opening; a hopper mounted upon the end wall and leading to the central opening; an annular sieve grating fixed upon the wall and extending axially inward into the housing; a series of rebound members rigidly spaced apart upon the interior of the sieve grating and inclined with respect to the periphery of the latter, the housing having a discharge opening for ground material sifted through said sieve grating located externally of the latter; a driven rotor rotatably mounted in said housing and spaced a predetermined axial distance from the end wall of the latter and having a series of grinding tools mounted thereon which extend toward said end wall in effective position to rotate with said rotor past said rebound means during operation; a second annular sieve grating fixed upon said end wall in concentric relation to and spaced a distance exteriorly of the first annular sieve grating; a second series of rebound members rigidly spaced apart upon the interior of said second sieve grating and inclined to the periphery of the latter; a second series of grinding tools mounted on said rotor and extending toward said end wall intermediate the two annular sieve gratings, the transverse section of each grinding tool of both series forming an angular geometrical figure and longitudinally having a torsional pitch from end to end and being tapered from one end to the other; passage means for leading off from the mill the ground and sifted material passing through the second annular sieve grating; and a portion in said housing of greater diameter than that of said second sieve grating for receiving the coarse grain material rejected from said second sieve grating externally of the periphery of said rotor.

6. A high speed centrifugal mill, comprising a mill housing having an end wall with a central opening; a hopper mounted upon the end wall and leading to the central opening; an annular sieve grating fixed upon the wall and extending axially inward into the housing; a series of rebound members rigidly spaced apart upon the interior of the sieve grating and inclined with respect to the periphery of the latter, the housing having a discharge opening for ground material sifted through said sieve grating located externally of the latter; a driven rotor rotatably mounted in said housing and spaced a predetermined axial distance from the end wall of the latter and having a series of grinding tools mounted thereon which extend toward said end wall in effective position to rotate with said rotor past said rebound means during operation; a

second annular sieve grating fixed upon said end wall in concentric relation to and spaced a distance exteriorly of the first annular sieve grating; a second series of rebound members rigidly spaced apart upon the interior of said second sieve grating and inclined to the periphery of the latter; a second series of grinding tools mounted on said rotor and extending toward said end wall intermediate the two annular sieve gratings, the transverse section of each grinding tool of both series forming an angular geometrical figure and longitudinally having a torsional pitch from end to end and being tapered from one end to the other; a third annular sieve grating of greater diameter than that of said second sieve grating extending axially inward in said housing from the inner side wall of the enclosed annular passage and peripherally exteriorly of the rotor for receiving the material of too coarse grain size to pass through said second sieve grating when moved axially inward from the latter; a second enclosed annular passage peripherally encircling said third annular sieve grating and having a delivery opening for delivering material ground and sifted through said third annular sieve grating; and a series of further members upon the rotor extending axially inward from the side thereof remote from said end wall and disposed at greater radial distances from the center of said rotor than the grinding tools of said second series.

JOSEF KLAGSBRUNN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
368,900	Ryerson	Aug. 23, 1887
643,273	Peer	Feb. 13, 1900
1,420,354	Williams	June 20, 1922
1,424,225	Williams	Aug. 1, 1922
1,646,720	Andrews	Oct. 25, 1927
1,773,906	Klagsbrunn	Aug. 26, 1930
1,820,462	Kittay	Aug. 25, 1931
2,227,435	Borton	Jan. 7, 1941

FOREIGN PATENTS

Number	Country	Date
50,070	Austria	Sept. 25, 1911
32,978	Denmark	Mar. 7, 1924
604,931	France	Feb. 6, 1926
452,783	France	May 23, 1913
842,939	France	Mar. 13, 1939
236,422	Germany	July 12, 1911
346,986	Germany	Jan. 12, 1922
373,289	Great Britain	May 26, 1932
395,788	Great Britain	July 27, 1933
106,165	Switzerland	Aug. 1, 1925
213,297	Switzerland	May 1, 1941