A. P. HACHTMANN.

TUBE MILL.

APPLICATION FILED MAR. 15, 1916.

1,290,178.

Patented Jan. 7, 1919.

4 SHEETS—SHEET 1.

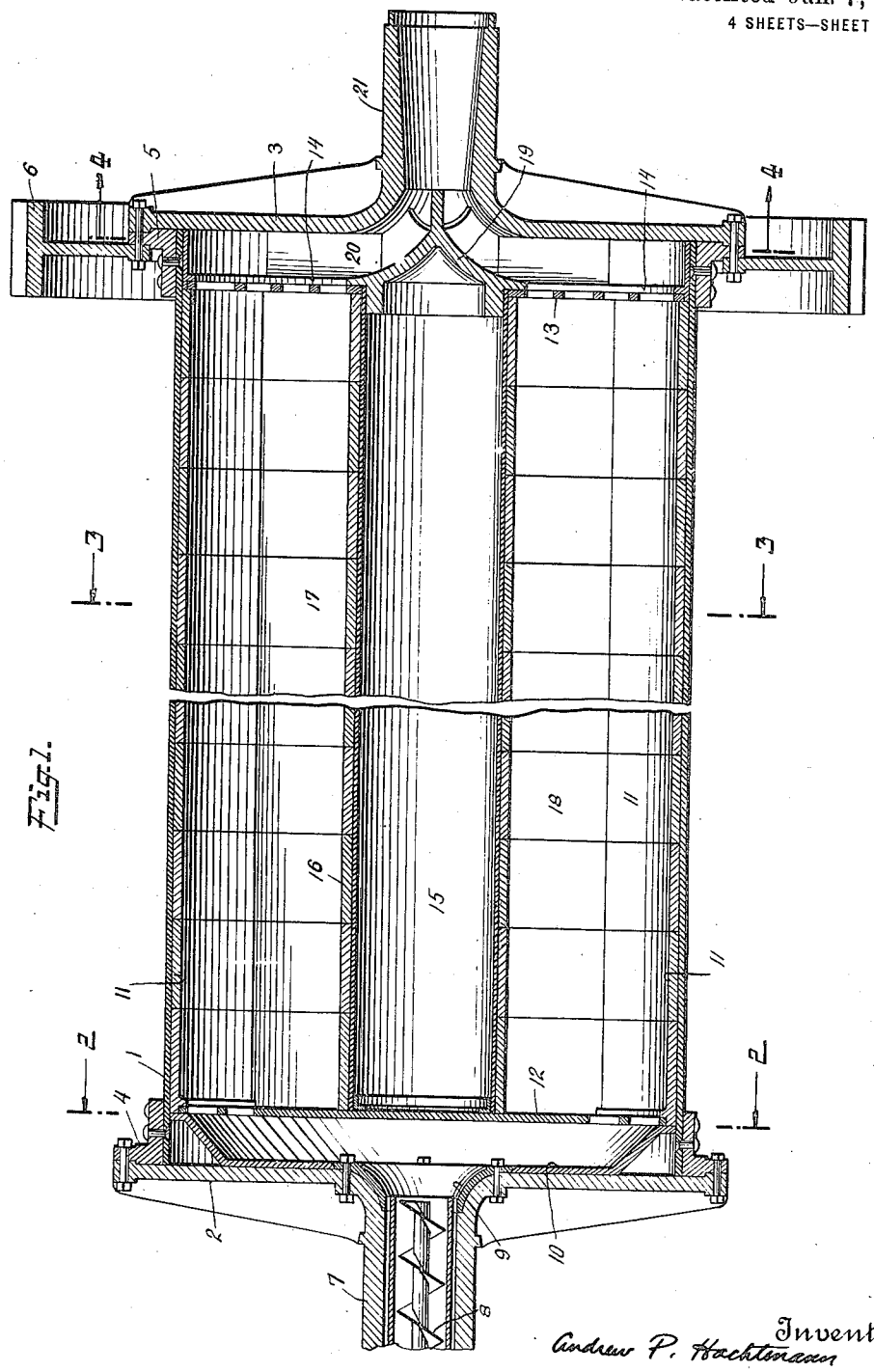


Fig. 1.

Inventor
Andrew P. Hachtmann

By his Attorneys
Pennie Davis & Marvin

A. P. HACHTMANN.

TUBE MILL.

APPLICATION FILED MAR. 15, 1916.

1,290,178.

Patented Jan. 7, 1919.

4 SHEETS—SHEET 2.

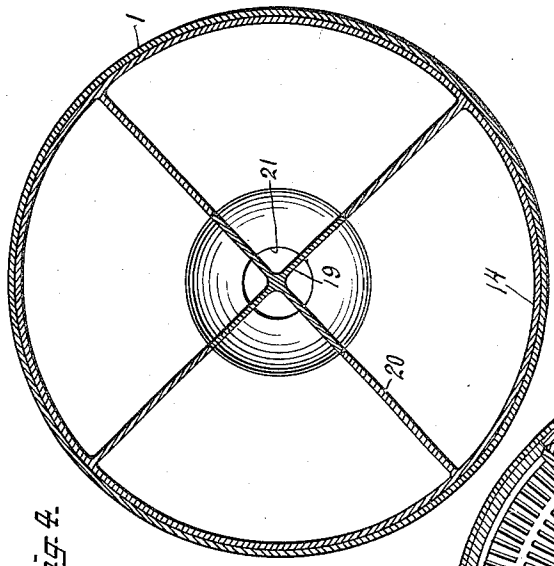


Fig. 4.

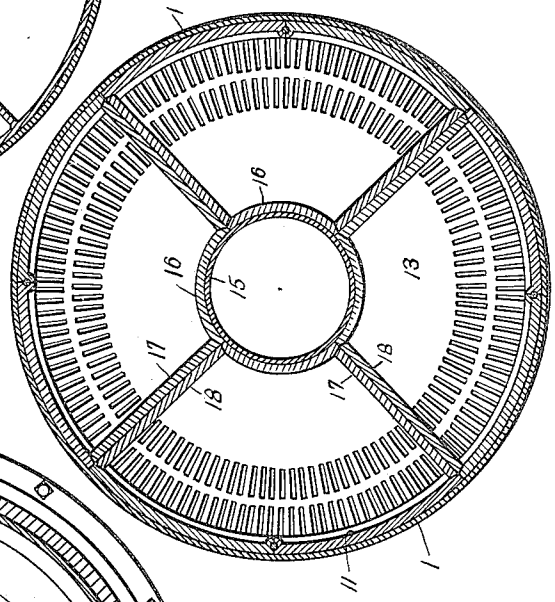


Fig. 3.

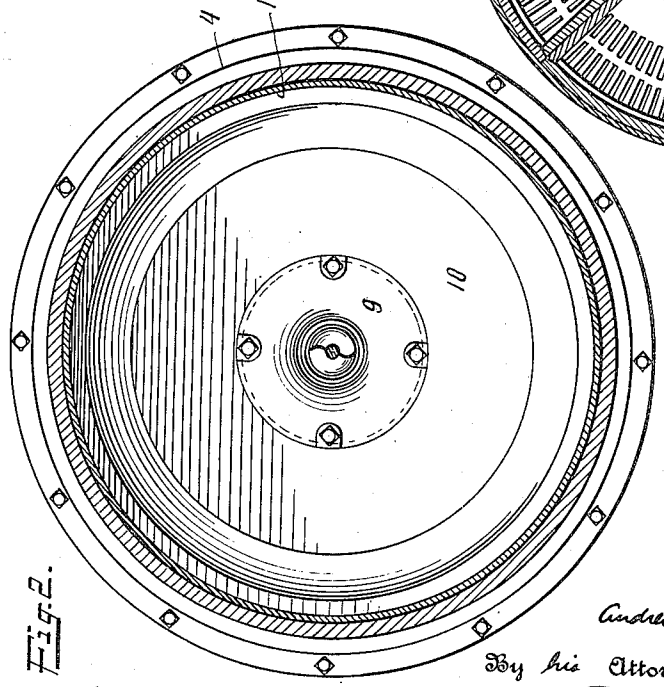


Fig. 2.

Inventor

Andrew P. Hachtmann

By his Attorneys

Pennie Davis Marvin

A. P. HACHTMANN.

TUBE MILL.

APPLICATION FILED MAR. 15, 1916.

1,290,178.

Patented Jan. 7, 1919.

4 SHEETS—SHEET 3.

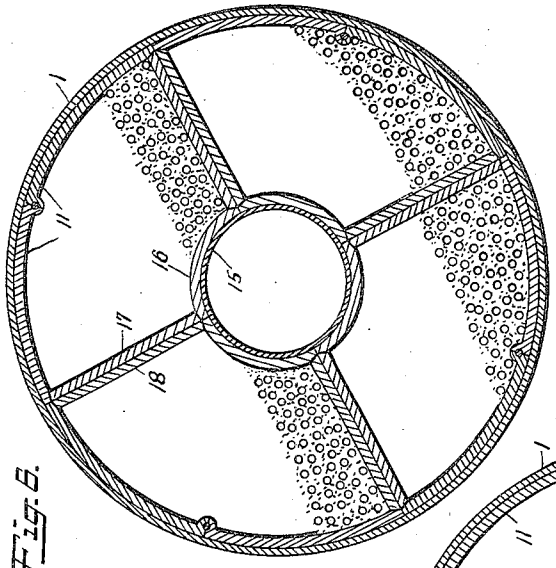


Fig. 6.

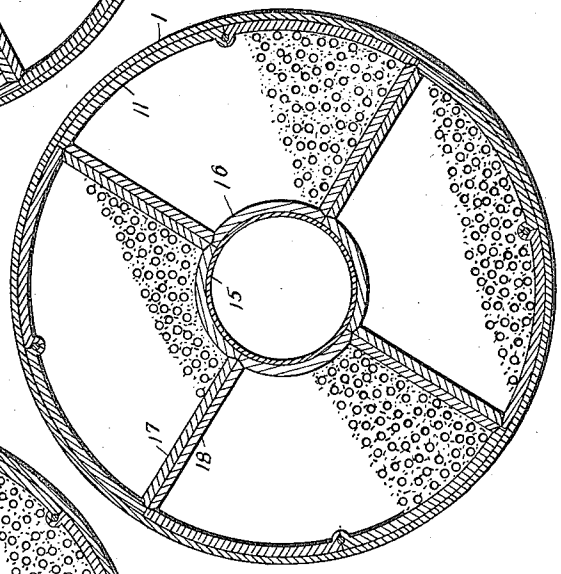


Fig. 7.

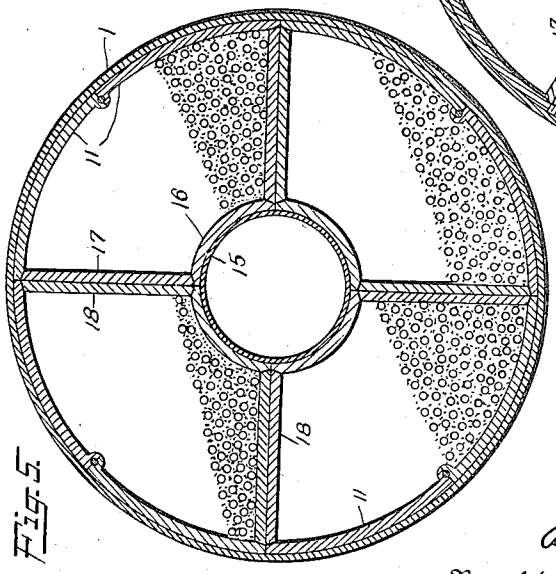


Fig. 5.

Inventor

Andrew P. Hachtmann

By his Attorneys

Pennie Davis & Marvin

A. P. HACHTMANN.

TUBE MILL.

APPLICATION FILED MAR. 15, 1916.

1,290,178.

Patented Jan. 7, 1919.

4 SHEETS—SHEET 4.

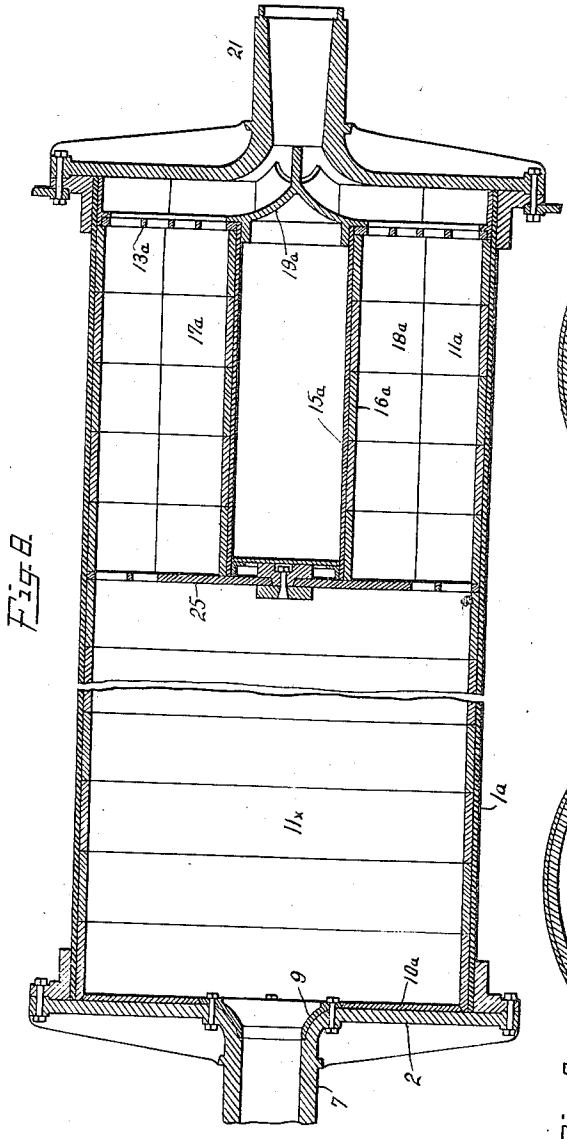


Fig. 8.

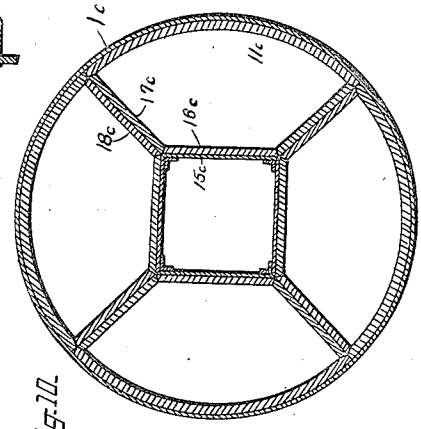


Fig. 10.

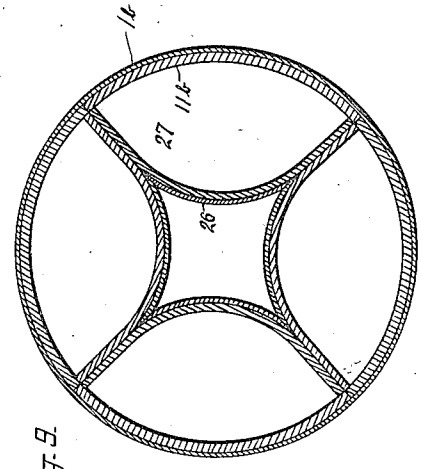


Fig. 9.

Inventor

Andrew P. Hachtmann

By his Attorneys

Pennie Davis & Marvin

UNITED STATES PATENT OFFICE.

ANDREW P. HACHTMANN, OF ALLENTOWN, PENNSYLVANIA, ASSIGNOR TO LEHIGH PULVERIZER MILL COMPANY, OF CATASAUQUA, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

TUBE-MILL.

1,290,178. Specification of Letters Patent. Patented Jan. 7, 1919.

Application filed March 15, 1916. Serial No. 84,275.

To all whom it may concern:

Be it known that I, ANDREW PETER HACHTMANN, a citizen of the United States, residing at Allentown, Lehigh county, State of Pennsylvania, have invented certain new and useful Improvements in Tube-Mills; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to improved constructions in tube or ball mills.

The usual type of tube mill is a hollow cylinder provided with an inlet and outlet for the material to be ground, and containing balls or pebbles which, during the rotation of the mill, reduce the material being acted upon to a fine powder.

The present invention relates to an improved construction in which the mill is interiorly divided into a plurality of independent compartments or sections extending longitudinally of the mill, but in which the central portion of the mill is provided with a framework, preferably hollow, and in which the separate sections or compartments are arranged at a distance from the center of the mill, and around the outside thereof. Thereby, the material being ground, and the pebbles or balls within the separate compartments, are kept away from the center of the mill and near the outer portion thereof. The pebbles or balls used for grinding the material may be of spherical or cylindrical or other suitable shape, and may be either of metal or of mineral or non-metallic material. The novel construction of the present invention is furthermore such that the number of independent sections or compartments are, preferably, four or more in number, so that the balls and the material being ground will be distributed upon both sides of the central portion of the mill, and will in part counter-balance each other, so that less power is required for the operation of the mill, and so that improved results will nevertheless be obtained.

In the preferred construction of the invention, the central framework of the drum and the radial partitions which divide the space between the central framework and the outer wall of the drum, are arranged to make abrupt angles or corners with each other, so that there will be four separate corners of each compartment which will cause an improved action of the balls during the rotation of the mill.

Certain structural embodiments of the invention are illustrated in the accompanying drawings, in which—

Figure 1 shows a mill embodying the invention, in central longitudinal section.

Fig. 2 is a sectional view of the mill taken on the line 2—2 of Fig. 1.

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 1.

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 1.

Figs. 5, 6 and 7 are sectional views illustrating the operation of the mill, and showing the balls and the material within the mill as they arrange themselves at different angles during the rotation of the mill.

Fig. 8 is a longitudinal sectional view of a modified construction; and

Figs. 9 and 10 are cross-sectional views of further modifications of the invention.

Referring first to Figs. 1 to 4, it will be noted that the tube mill is made up of the outer cylinder 1 united to the heads 2 and 3 by suitable means, such as angle irons 4 and 5. Suitably bolted or otherwise secured to the angle iron 5 and the head 3 is a gear 6 by means of which the mill is rotated. The arrangement and structure of the driving mechanism can, however, be varied, and in itself forms no part of the present invention.

The head 2 at the feed end of the mill is provided with a hollow inlet or feed portion 7 having a suitable conveyer such as a screw conveyer 8 therein. Within the head 2 is a lining plate 9 and the lining and spacing plate 10, arranged to form with the perforated plate 12, a compartment for receiving the material to be ground from the inlet. The header or perforated plate 12 is held between the lining plate or disk 10 and the end lining plates 11, which are of a sectional nature and which line the main portion of the cylinder 1.

A similar discharge header or plate 13 is arranged at the discharge end of the mill and is suitably clamped between the end

sections 11 and the ring 14, which has suitable radial vanes secured to or integral therewith and arranged between the disk 13 and the head 3 of the mill. The vanes 20 cooperate with the member 19 having corresponding vanes and serve to discharge the material from the drum to the discharge 21.

The particular nature of the feed and discharge mechanism can be varied, and various types of construction are available for this purpose without departing from the invention. That illustrated is accordingly to be considered one suitable form of inlet and outlet mechanism.

Centrally arranged within the mill and extending between the inlet and outlet disks or headers 12 and 13, is a central framework 15, preferably made hollow, shown in Figs. 1 and 3 as a central cylinder suitably supported by the plates or disks 12 and 13, and closed at its ends. Lining plates 16, of a sectional construction, are arranged around the drum 15. Extending between the central framework and the outer walls of the mill are the radially arranged dividing plates 17 and 18, suitably secured in place between the lining members 11 and 16.

The lining members 11 and 16, and also the division plates 17 and 18, may be of metal, suitably chilled or hardened or they may be of a mineral composition, such as silex, the material being of a nature which will resist the wear to which the lining plates are subjected.

The arrangement of the lining plates and radial division plates may also, with advantage, be such that these plates interlock with each other so that no independent fastening means will be necessary. The edges of the plates, where they come together, may, to this end, be suitably beveled or machined, so that, when the various plates are put in place from one end of the drum, they will remain interlocked and incapable of dislocation during the operation of the mill. By making the lining plates in sections, it is easy to insure that the individual sections are properly hardened or tempered, while it is also possible to avoid joints except where the radial and circumferential lining plates come together at the corners of the separate compartments. Because the outer lining plates 11 have a larger surface to cover between the radial division plates, they may, with advantage, be divided in the middle, as shown, and a suitable device provided at the point of union, thereby further strengthening and reinforcing the lining plates.

The operation of the novel tube mill of the present invention is illustrated, diagrammatically, by the cross-sectional views of Figs. 5, 6 and 7. In these views it is assumed that the mill rotates counter-clockwise, and these views show the mill with the radial dividing plates 17 and 18, at positions about 30 degrees in advance of the preceding position, so that Figs. 5, 6 and 7 represent the complete cycle of operations which takes place during the rotation of the mill through an angle of 90 degrees. This action will accordingly be repeated four times during one complete rotation of the mill, where the compartments are four in number. With an increased number of compartments, the number of cycles during each complete revolution of the drum will be correspondingly increased.

It will be noted, from Figs. 5, 6 and 7, that the balls and the material being ground are kept away from the center of the drum by the hollow central framework. This arrangement presents, among others, the following advantages. The radial movement is materially decreased, so that the entire grinding action takes place near the outside periphery of the mill, and without the balls and the material passing to the center of the drum, from which they would require to be in turn raised and moved during subsequent rotation. The provision of a hollow central framework, furthermore, in addition to keeping the material away from the center of the drum, provides two abrupt inner angles or corners in the construction of Figs. 1 to 8 which cause the balls to move over each other and thereby grind the material instead of simply sliding as a body around the walls of the compartments. So also, by keeping the balls and the material away from the center of the drum, so that the material is always nearer the outer periphery thereof, the balls and material on opposite sides of the center of the drum tend to counter-balance each other to a material degree, thereby decreasing the power which is necessary to operate the mill while nevertheless resulting in an improved grinding action.

In the modified construction of Fig. 8, the central framework extends only part of the length of the mill, and the remainder of the mill is left free from obstruction and from the central framework, much as in the constructions of tube mills heretofore used. The header 2, inlet 7, and lining plates 9, 10^a and 11^x, as well as the cylinder 1^a, are similar to the corresponding parts of Fig. 1. The inlet plate 25 which serves to feed the material into the sectional compartments is held between the lining plates 11^x and 11^a, and suitably supports the central drum or framework 15^a in any suitable manner. The lining plates 11^a and 16^a, and the division plates 17^a and 18^a, also correspond to the lining and division plates of Fig. 1, as do also the outlet elements 13^a, 19^a and 21.

In this modified construction, the material is fed into the inlet compartment of the mill, by means not shown, and the grinding action takes place therein much as in the usual

tube mill. The material then passes through the radial slots in the plate 25 and into the longitudinal compartments between the central framework and the outer periphery of the drum, and is here given a further grinding of the nature above described. The ground material then passes out through the outlet of the mill in much the usual manner. It will accordingly be noted that the inlet compartment of Fig. 8 itself forms a part of the tube mill, and is intended to operate in much the usual manner, while the inlet compartment of Fig. 1 is for the purpose of feeding the material to the radial slots in the plate 12 and thence into the compartments between the central framework and the outer portions of the drum. These radial slots are illustrated in Fig. 3 as somewhat larger than those which are usually employed in practice, but it will be understood that the size of these slots can be varied in accordance with the particular material being ground and the particular results desired.

Figs. 9 and 10 show, in cross-section, further modifications of the invention. In Fig. 9, the cylinder 1^b and the lining plates 11^b are similar to those of Figs. 1 and 8. The central framework is, however, of a different nature, and is made up of the inner framework 26 and the lining plates 27 which, together with the lining plates 11^b, form the sides of the separate compartments. With this construction, the advantages incident to the provision of a plurality of abrupt angles between the radial division plates and the lining plates of Fig. 1 are not obtained, or are obtained to a much less degree; while the advantages incident to keeping the material away from the center of the drum are nevertheless retained.

In the modified construction of Fig. 10, the drum 1^c and the lining plates 11^c and 16^c, as well as the radial division 17^c and 18^c, correspond to the elements of Fig. 1, but the central hollow framework 15^c is square instead of round, and the lining plates 16^c are accordingly straight instead of curved. The angle between the plates 16^c and the radial plates 17^c and 18^c is somewhat increased, but a plurality of angles are nevertheless presented having advantages of a nature similar to those above pointed out.

It will accordingly be noted that the present invention provides for the grinding of the material, and the operation of the balls or pebbles, in separate compartments, which are arranged away from the central portion of the drum, and which are arranged between the central framework and the outer cylindrical portion of the drum. It will further be noted that the lining plates can, with advantage, be so introduced that the various plates interlock with each other and require no other fastening means to hold them in place. The number and nature of these lining plates can of course be varied, and will naturally be varied in the construction of mills of different types and for different purposes.

I claim:

1. A rotative tube mill provided with inlet and outlet compartments for the material to be ground, and a plurality of independent longitudinally arranged grinding compartments arranged away from the central portion of the mill and communicating at their ends with the outer portions of said inlet and outlet compartments and rotative with the tube of the mill, said longitudinally arranged grinding compartments being constructed with a plurality of abrupt corners to promote the desired grinding action, substantially as described.

2. A tube mill comprising a rotatable drum provided with inlet and outlet compartments for the material to be ground, and a plurality of independent longitudinally arranged grinding compartments arranged away from the central portion of the drum and around the outer periphery thereof and communicating at their ends with the outer portions of said inlet and outlet compartments, said longitudinally arranged grinding compartments being constructed with a plurality of abrupt corners to promote the desired grinding action, substantially as described.

3. A tube mill comprising a rotatable drum having therein a hollow central framework and a plurality of independent longitudinally arranged grinding compartments for tumbling grinders arranged between said hollow central framework and the outer periphery of the drum, and means for feeding to and discharging from said compartments the material to be ground, substantially as described.

4. A tube mill comprising a rotatable drum provided with suitable inlet and outlet compartments at its ends for the material to be ground, a central hollow framework within said drum, radial division plates arranged between said framework and the drum and dividing the space surrounding said framework into a plurality of separate grinding compartments arranged away from the central portion of the drum, and means for feeding the material to said compartments from the outer portion of said inlet compartment and for discharging the same therefrom to said outlet compartment, substantially as dedescribed.

5. A tube mill comprising a rotatable drum provided with a central hollow drum and with radial division plates arranged between said central drum and the outer drum and forming a plurality of independent longitudinally arranged grinding compartments for tumbling grinders, and means for

feeding to and discharging from said compartments the material to be ground, substantially as described.

6. A tube mill comprising a rotatable drum provided with transverse division plates or headers arranged near the ends of the drum to form with the ends of the drum inlet and outlet compartments for the material to be ground, a central hollow framework extending between said headers or plates and supported therefrom, division plates also arranged between said headers and between the central framework and the outer walls of the drum and forming a plurality of independent grinding compartments, said headers being provided with perforations near their outer portions for feeding to and discharging from said compartments the material to be ground, substantially as described.

7. A tube mill having therein a plurality of independent longitudinally arranged grinding compartments, and sectional lining plates forming the inner walls of each of said compartments constructed and arranged to interlock with and hold each other in place, substantially as described.

8. A tube mill comprising an outer drum, a centrally arranged hollow frame work, and radial partitions dividing the space therebetween into a plurality of longitudinal compartments, each partition comprising lining plates for adjacent walls of adjacent compartments, the other lining plates of the compartments interlocking with and holding the partition plates firmly in position, substantially as described.

9. A tube mill comprising a rotatable drum provided with partition plates or headers arranged between the heads of the drum and spaced away therefrom to form inlet and outlet compartments, a central drum arranged between and supported by said partition plates or headers, and radial division plates between said central drum and the main drum forming therewith a plurality of independent grinding compartments, said partition plates or headers being provided with perforations near their outer portions for permitting passage of the material to be ground to and from said compartments, substantially as described.

In testimony whereof I affix my signature, in presence of two witnesses.

ANDREW P. HACHTMANN.

Witnesses:

F. A. MOHN,

GEORGE KOPP.