J. S. FASTING.

TUBE MILL.

APPLICATION FILED AUG. 31, 1916.

1,295,290. Patented Feb. 25, 1919.

Fig. 1.

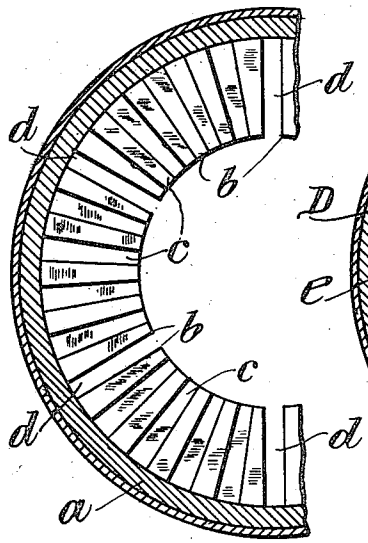


Fig. 2.

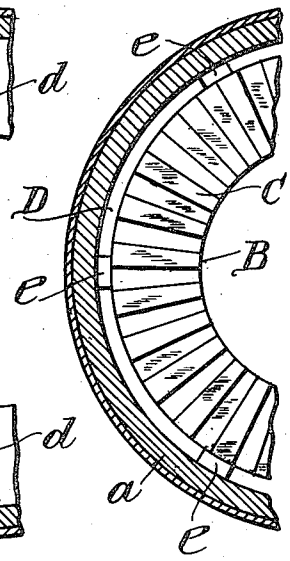


Fig. 3.

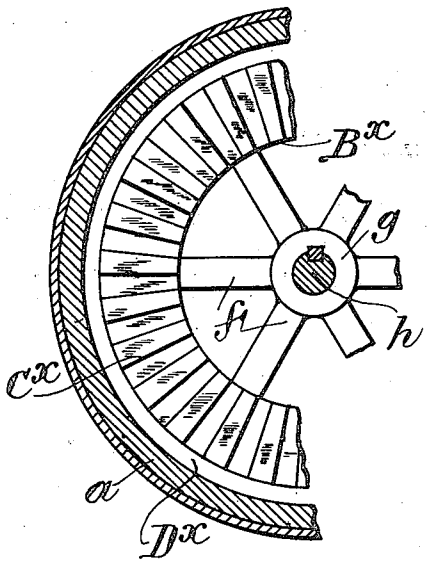


Fig. 4.

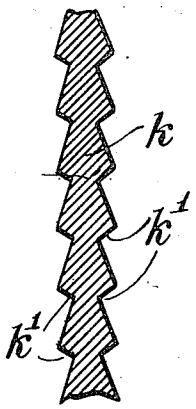


Fig. 5.

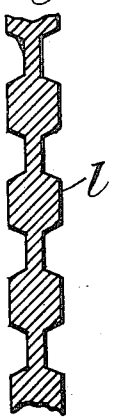


Fig. 6.

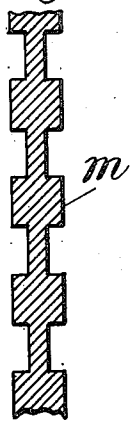


Fig. 7.

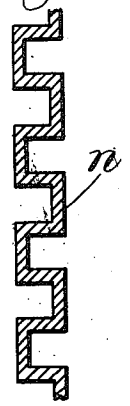


Fig. 8.



WITNESS

INVENTOR

BY

ATTORNEYS

UNITED STATES PATENT OFFICE.

JOHAN S. FASTING, OF FREDERIKSBERG, NEAR COPENHAGEN, DENMARK, ASSIGNOR TO F. L. SMIDTH & CO., OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

TUBE-MILL.

1,295,290. Specification of Letters Patent. Patented Feb. 25, 1919.

Application filed August 31, 1916. Serial No. 117,854.

To all whom it may concern:

Be it known that I, JOHAN S. FASTING, a subject of the King of Denmark, residing at Frederiksberg, near Copenhagen, Denmark, have invented certain new and useful Improvements in Tube-Mills, of which the following is a specification, reference being had to the accompanying drawings, forming a part hereof.

In Letters Patent of the United States No. 1,204,554, dated November 14, 1916, there is shown and described an improved method in the art of grinding with free grinding bodies which consists in producing in the mill a slowly rotating mass of grinding bodies and material to be ground and applying closely related frictional lifting ribs having surfaces extending in the direction of rotation to said mass while rotating. As suggested in the specification of said patent, the closely related lifting surfaces might have their gripping action accentuated by roughening the faces of the lifting ribs so as to increase the friction between the ribs and the material. The present application is concerned with a grinding mill provided with frictional lifting ribs of the general character claimed in said patent and seeks to cover, specifically, lifting ribs having roughened or corrugated faces or steps on such faces for the purpose of affording positive support to a substantial portion of the mass between adjacent ribs and thereby increase the lifting effect of the ribs partially by such positive support and partially by the increased frictional drag of the faces on the charge. In practising the invention, the charge is separated into parallel, circumferential streams by the annular partitions and each stream is wedged between proximate ribs so that the charge therein will be carried up the wall of the mill partially by the positive lifting action of the irregular faces of the ribs and partially by the lateral support afforded by the frictional engagement of the charge with the ribs. In accordance with the present invention the annular partitions may be formed in a number of different ways but afford, in each embodiment, provision for free longitudinal movement of the material through the mill. The structural details of the illustrated embodiments and the permissible range of equivalents will all appear with greater particularity hereinafter in connection with the description of the accompanying drawings, in which—

Figure 1 is a fragmentary view in transverse section through the wall of the mill on the inner surface of which are secured annular partitions formed of lifting ribs constructed in accordance with the invention.

Fig. 2 is a view similar generally to Fig. 1 but showing a partition composed of a somewhat different form of rib.

Fig. 3 is a view similar generally to Figs. 1 and 2, but showing still another form of partition constructed in accordance with the invention.

Figs. 4–8 are fragmentary detail views in section taken through ribs having roughened lifting surfaces in accordance with this invention and adaptable for use in any one of the mills shown in Figs. 1–3.

As pointed out in the preamble, the improved method of grinding set forth in the patent referred to consists in applying closely related frictional lifting partitions on the inner wall of a mill, whereby upon rotation of the mill these partitions will separate the charge into parallel circumferential streams and thereby add lateral support to the lifting action of the centrifugal force derived from rotation of the mill. The present invention contemplates the employment of the same method of grinding with free grinding bodies in that the charge is broken up into parallel, circumferential streams by closely related annular partitions and support is given to each of these streams by the partitions in order to supplement the lifting action of centrifugal force derived from rotation of the mill. In accordance with the present invention, however, mere lateral support of the streams, such as would be derived from impressing frictional lifting surfaces on the sides of the streams, is not relied upon entirely, but the surfaces of the annular partitions or ribs are formed of such cross-sectional contour as to afford, to an appreciable degree, a positive support for a substantial portion of the charge within the streams. The provision of such irregularly formed surfaces on the annular partitions or ribs also insures a marked increase in the wedging action on the charge in each stream and a corresponding increase in the lateral support afforded to the charge through this wedging action. It is to be noted that wherever the term "partition" is employed in the

specification and claims, it is intended to cover any elements, whether integral or sectional, whereby a dividing or partitioning action is effected.

Referring now to the embodiments shown in the accompanying drawings, which will serve to emphasize some of the forms of the present invention, it will be seen that in Fig. 1, there is secured to the inner wall of the mill *a*, a partition *b* made up of a series of ribs or flanges *c* which are secured to the inner wall of the mill and are spaced from one another circumferentially so as to leave spaces *d* between the proximate ends thereof for the free discharge of the material longitudinally of the mill. No matter what form the broad invention assumes, it is to be emphasized that there are always provided in the partitions, suitable openings or spaces or the like to permit free longitudinal movement of the material through the mill for the purposes of discharge or distribution. Such movement is permitted in Fig. 1 by spacing the arcuate ribs *c* from one another circumferentially of the mill so as to leave spaces therebetween.

In Fig. 2 it will be seen that the partition B is made up as a single integral annular rib C of smaller diameter than the inner diameter of the mill and this rib is secured in place by lugs or feet *e* interposed between the rib and the wall of the mill at suitable intervals around the periphery of the rib. By mounting the rib C in the manner described, it will be evident that there is an annular space D left between the rib and the lining of the mill for free longitudinal movement of the material through the mill.

Still another form of partition B^x is shown in Fig. 3. This partition, like that shown in Fig. 2, is formed as an unbroken annular rib C^x of smaller diameter than the inner diameter of the mill. This integral rib is supported on a suitable spider *f*, the radial arms of which are carried on a hub *g* keyed on a suitable supporting shaft *h* which may be mounted coaxially with the mill and extend therethrough. In this embodiment the parts are so dimensioned as to leave an annular space D^x between the inner lining of the mill and the outer periphery of the rib C^x which space is of the same general character as the space D shown in Fig. 2 and permits free longitudinal movement of the material through the mill.

Thus far it has been sought only to discuss three of the many forms which the partitions embodying the invention may assume, in an endeavor to emphasize that the invention is not to be limited to the particular means for forming these partitions or of mounting them in the mill so as to perform their intended functions and yet permit free longitudinal movement of the material through the mill. The invention, however, is primarily concerned with the specific character of the ribs employed in the formation of these partitions since the character of the partitions themselves differs in no wise in this application from that contemplated in the original case.

In Figs. 4–8 there are illustrated in section, by way of example, five different forms of ribs which embody the present invention and may be employed in the partitions shown in Figs. 1–3. The characteristic feature of these ribs resides in the provision of radial shelves which shall afford a positive lifting action for an appreciable part of the mass in the circumferential streams and incidentally increase appreciably the lateral support given by the frictional drag impressed on this mass by the rib. The rib *k* shown in Fig. 4 has annular grooves or corrugations *k'* formed on its opposite faces, these grooves being of such shape as to give positive support to the material resting in the grooves and impress on the mass a frictional drag which shall serve to insure a wedging action sufficient to carry the charge part way up the wall of the mill and to a point beyond where centrifugal force alone would carry it. The shape of the grooves, however, it will be noted, is such as to permit the charge to fall from the face of the rib immediately upon the breaking down of the aforementioned wedge or arch.

In principle, and general cross-sectional appearance, the construction and operation of the ribs *l*, *m* and *n* shown in Figs. 5–7, respectively, are very similar to the construction and action of the rib shown in Fig. 4. These ribs are grooved on their opposite faces to permit the charge to enter and be given appreciable positive support and be subjected to an increased gripping action for the substantial lateral support desirable for the successful practice of the method.

The rib *o* shown in Fig. 8, while of somewhat different contour, is intended to function in the manner described in connection with the other ribs shown in the drawings. This rib is corrugated and its grooves instead of being angular in cross-sectional outline are curved.

It will be understood that the positive support afforded by the ribs in accordance with the improvements may be varied through wide ranges by changing the cross-sectional contour of the grooves between one which is most abrupt and angular, such as is suggested in Figs. 6 and 7 to one with gently rounded grooves of the character suggested in Fig. 8.

As pointed out hereinbefore, the partitions in Figs. 1, 2 and 3 may be made up either with unbroken ribs spaced from the wall of the mill or may be formed with a circumferential series of short arcuate ribs

(as in Fig. 1) the primary functions of the partitions being preserved in either case and free longitudinal movement of the material through the mill being provided for. The partition itself may be formed of an unbroken rib or ribs of the character described in connection with the several embodiments shown in Figs. 4–8, the supplemental positive lifting action which is the gist of this invention being retained in all of these forms.

I claim as my invention:

1. A tube mill consisting of a drum having a peripheral lining and a diametric partition with its periphery adjacent said lining and having its opposite side forming radially extending shelves.

2. A tube mill consisting of a drum having therein a diametrical partition with a central opening, said partition formed of imperforate sections each of which has radial grooves in its opposite sides opening longitudinally of the drum.

This specification signed this 9th day of May, A. D. 1916.

JOHAN S. FASTING.