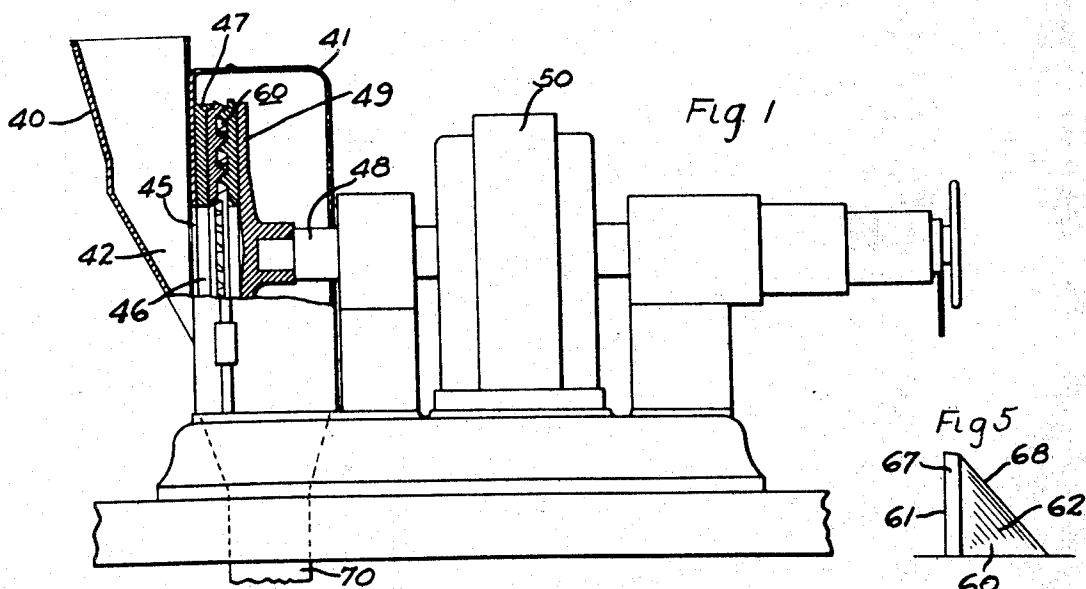
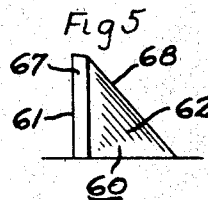
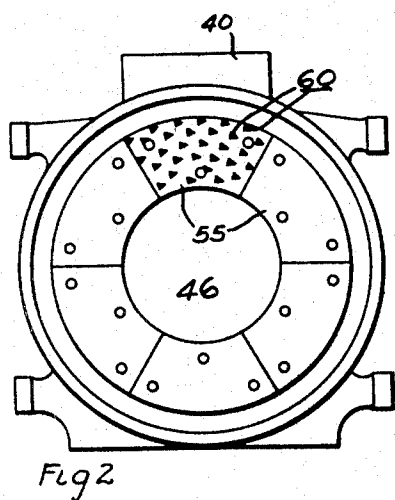
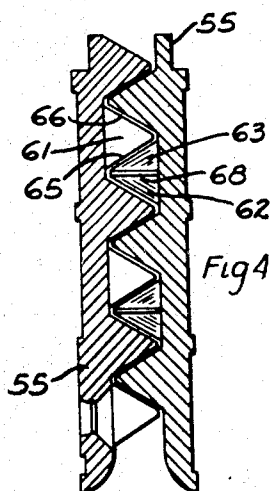
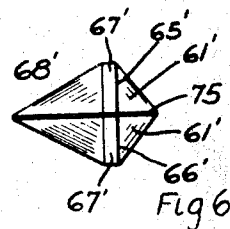
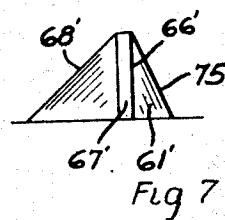
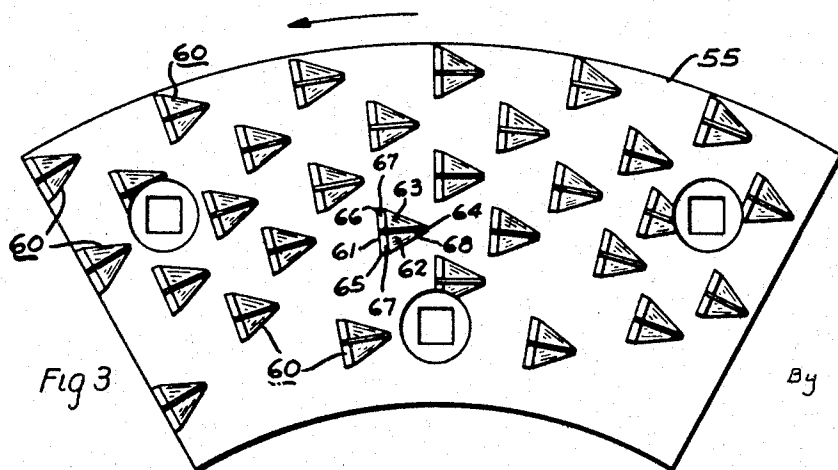


Dec. 24, 1940.

W. F. HALL
ATTRITION MILL
Filed Oct. 18, 1937

2,226,429



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2,226,429

ATTRITION MILL

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Application October 18, 1937, Serial No. 169,560

5 Claims. (Cl. 83-8)

This invention relates to attrition mills and more particularly to a novel form of plate for use in such a mill.

One of the principal objects of the invention is to provide a new and improved tooth structure for the plates of an attrition mill which is particularly adapted for the rapid and efficient shredding of tough fibrous material, such for example as cellulosic fibrous material.

Another object is to provide such tooth structure which has a cutting or shredding surface and a rearwardly extending surface which is relieved to avoid wedging or packing of the teeth and to avoid objectionable grinding of the fibrous material.

A further object of the invention is the provision of an attrition mill plate of this character which is particularly adapted to be employed in a method of treating wood pulp so as to change it into a condition which permits of satisfactorily subjecting it to those treatments in the nitrating field which have been heretofore available and used in treating cotton linters and the like.

Other objects and advantages of the invention will be apparent from the description, claims hereinafter set out, and the accompanying drawing.

In the drawing, in which like characters of reference designate like parts throughout the several views thereof,

Fig. 1 is a view, partly in elevation and partly broken away in section, somewhat diagrammatic in character, showing an embodiment of an attrition mill constructed in accordance with the invention;

Fig. 2 is an elevational view of the stationary head of the attrition mill showing the toothed plates thereon;

Fig. 3 is a plan view of one of the plates for the attrition mill and illustrates the form of the teeth provided thereon;

Fig. 4 is a sectional view through the opposed plates of the attrition mill and shows the construction of the plates, the teeth thereon, in detail;

Fig. 5 is a side elevational view of one of the teeth; and

Figs. 6 and 7 are a plan view and a side elevational view, respectively, of a modified form of tooth for the attrition mill plates.

In the usual attrition mill means are provided for feeding the material to be treated into the space between two plates which have relative movement with respect to each other, the material being supplied toward the axis of the plates,

and passing between the plates where it is acted upon and caused to move outwardly toward the periphery thereof. In accordance with the present invention a form of plate carrying a plurality of teeth is provided which is highly effective in securing a desired shredding or cutting action upon fibrous materials, and particularly upon relatively tough fibrous materials such as cellulosic fibrous material or wood pulp. The tooth structure is such that a momentary cutting or shredding action is secured upon the face of the tooth and this action is immediately relieved, the portion of the tooth rearwardly of the cutting face in the direction of movement being provided with surfaces which taper towards each other and towards the body of the plate to relieve the shearing action on the fibrous material as it leaves the cutting face, thereby avoiding undesirable grinding of the fibrous material and the tendency for the material to wedge between the teeth, and resulting in a highly effective and efficient operating characteristic.

An attrition mill of this character, while having general utility in the treatment of various materials, is particularly adapted to defiberize wood fibers in a process for producing a nitratable cellulosic material from ordinary commercial wood pulp such as is widely used in the paper industry. Through the practicing of such process, there has been satisfactorily produced from standard commercial wood pulp, a cellulosic material similar in appearance and operative characteristics to cotton linters and readily adaptable for the treatments given cotton linters and the like in the manufacture of explosives, lacquers, cellulose acetates and the wide range of other products which result from reactions with cellulose and generally referred to herein as nitrating. The present invention thus makes available for nitrating a highly satisfactory and quite inexpensive fibrous material.

Referring to the drawing the reference numeral 40 designates the hopper of a machine known in the industry as a single head attrition mill. Attrition mills as such are of course well known in industry having had a wide variety of uses in many fields of industry for many years. The invention, however, provides a new and improved attrition mill, in which the operating disks are provided with teeth particularly adapted to shred and defiberize tough fibrous materials such as the wet fibrous material of the process herein described. The attrition mill as shown comprises a casing 41, which houses the operating disks for treating the material. Attached to

this casing is an inlet 42, to which the feed hopper 40 is attached. This inlet delivers into a centrally arranged opening 45 which in turn opens through a central opening 46 in a stationary part of the housing or head 47, which is rigidly secured to the casing 41. Mounted within suitable bearings which are carried by pedestals is a drive shaft 48 which carries thereon, within the housing 41 a cooperating head 49, this shaft being driven, as shown, by a suitable motor 50.

The stationary head and the rotary head each has suitably mounted thereon in face to face relation, a set of sector shaped plates 55, an elevational view of one of the heads with the plates in position thereon being shown in Fig. 2, and the detail construction of the segments of each plate section being shown in Figs. 3, 4 and 5.

As shown in Figs. 2 and 3 each of the plates 55 is provided with a plurality of teeth, the teeth on the plates which are to be attached to the stationary head and the teeth on the plates which are to be attached to the rotary head being respectively so located that, as shown more particularly in Fig. 4, these teeth will mesh, as it were, during operation of the mill. That is to say, the teeth are arranged on the plates of the respective disks in circular rows which are concentric with the axis of the disks, the rows being so positioned radially relative to said axis, that the teeth in the respective circular rows of the rotating head travel between the teeth in adjacent circular rows of the stationary head. The rows are preferably so positioned that there is a clearance of approximately $\frac{1}{16}$ " between the shearing edges of the teeth on the rotating head and those on the stationary head as the disks rotate relative to each other. The teeth in adjacent circular rows of each plate are preferably arranged in staggered relationship as shown.

The teeth are of the form shown particularly in Figs. 3, 4 and 5, and are designated generally by the numeral 60. Each tooth consists of a substantially triangular shaped shearing face 61 and substantially triangular shaped side faces 62 and 63 which are arranged at diverging angles to the shearing face and taper downwardly from the apex of the shearing face to substantially a point on the plate 55, as indicated at 64, to provide a wedge-shaped tooth of substantially triangular cross section in any plane passing through the tooth. The shearing face 61 is arranged in a plane which is substantially radial to the shearing head and which is substantially perpendicular to the face of the plate 55. The shearing face 61 and side faces 62 and 63 provide shearing edges 65 and 66 which lie in said radial plane. The teeth are so arranged on the plates of the rotating head and in the plates of the stationary head, that the shearing edges 65 and 66 lead as the disks are rotated relative to each other, as indicated by the arrow in Fig. 3. It is thus apparent that each tooth comprises substantially one-half of a four sided pyramid with the apex of the pyramid leading as the disks rotate with respect to each other.

For the purpose of providing a wearing surface at the shearing edges the side faces 62 and 63 are provided adjacent the shearing face 61 with portions 67 which extend substantially perpendicular to the plane of the shearing edges. In this manner the shearing edge is maintained sharp for a longer period than would be the case if the tooth tapered directly from the edges 65 and 66. For a similar reason the top edge of the tooth is flattened somewhat as indicated at 68.

Very good results in the treatment of wood pulp to produce a nitratable cellulosic material have been obtained with an attrition mill in which the heads have a diameter of thirty-six inches, the rotatable head rotates at 1200 R. P. M., and the teeth have a width of three-fourths of an inch at the base of the shearing edges, a length of three-fourths of an inch from the shearing face 61 to the trailing edge 64, and a height of approximately three-fourths of an inch from the base of the shearing face to the apex thereof. With teeth of this size the wearing surfaces 67 are made one-eighth of an inch in width and the flattened portion 68 about one-sixteenth of an inch wide. It is to be understood, however, that these dimensions are only illustrative of an embodiment of the invention which has been found satisfactory in treating wood pulp and are not intended as a limitation upon the size of the attrition mill or the teeth therefor.

The wet material from the conveyor 30, which is of a size which will feed readily through the feed opening or eye of the attrition mill, passes into the space between the relatively rotating disks where it is acted upon by the teeth 60, being discharged, under the centrifugal action, at the periphery of the disks and passing outwardly through the discharge outlet 70. As the wet pulp material travels between the plates it is subjected to a plurality of successive momentary shearing operations each followed immediately by a release of the shearing action and the fibers of the pulp are separated and modified so that when dried, after it is discharged through the outlet member 70, it will very closely resemble cotton linters in its appearance and characteristics and the material is readily susceptible to treatment within the nitrating field described.

In Figs. 6 and 7 of the drawing there is illustrated a modified form of tooth which may be found desirable in shredding material of a particularly tough or sticky nature, such for example as nutmegs, green wood chips, etc. This same tooth is particularly applicable to the defibering of rags, leather, etc., and to the granulating of friable materials such as soap chips, molding compounds, etc. In this form of the invention the shearing face of the tooth is provided with a pair of triangular shaped tapered surfaces 61' which provide a leading edge 75 and serve to direct the material towards the shearing edges 65' and 66'. The shearing edges are provided with the wearing surfaces 67' and the leading edge 75 as well as the trailing edge 68' are flattened slightly to provide a better wearing surface thereon. With teeth of this structure the leading edge 75 gives a preliminary separation of the material operated upon, and the faces 61', being beveled, tend to be self-cleaning and prevent the accumulation of material in front of the tooth.

While the plates 55 for the attrition mill heads are shown as having teeth of uniform size it is evident that the teeth in the respective circular rows of the plate may be of different sizes and height. Thus the innermost or the outermost row of teeth relative to the axis of the attrition mill may be of a relatively large size and the teeth in the succeeding rows of a gradually decreasing size or height. The number and spacing of the teeth in the various rows may also be varied as desired, and the number and spacing of the teeth in one or more rows of one plate may be different from that of the meshing teeth on the opposed plate.

While the method and forms of apparatus

herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to this precise method and these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In an attrition mill of the character described, a shearing head for said mill, a plurality of teeth arranged on a face of said shearing head and adapted to cooperate with similar teeth on an opposite face, each of said teeth having a plurality of faces arranged to provide a plurality of shearing edges lying in a plane substantially radial to the head and substantially perpendicular to the face of the head, the side faces of said teeth being arranged to taper downwardly towards the face of said head at converging angles to the plane of said shearing edge to provide a wedge-shaped tooth of substantially triangular cross-section in any radial plane passing through the tooth, and the forward faces of said teeth being arranged to taper downwardly towards the face of said head at converging angles to the plane of said shearing edge to provide a beveled shearing face for the tooth adapted to have a substantially uniform spacing with respect to teeth on said opposite face, the body of each of said teeth to the rear of said shearing face being relieved to avoid objectionable rubbing of the material between the bodies of cooperating teeth following the shearing action thereof.

2. A rotatable substantially flat plate for use in an attrition mill and the like in conjunction with a similarly formed opposite plate and adapted to produce a granulating and shredding action with reduced friction and rubbing contact comprising teeth projecting from the face of said plate and arranged to have spaces therebetween in both radial and angular directions, each tooth having a substantially triangular-shaped leading face with its plane extending substantially normal to and lying along a radius of the plate and adapted to have predetermined interfitting engagement with similar teeth on the cooperating plate forming shearing edges along both sides of said face substantially uniformly spaced from the shearing edges of the adjacent plate, the body of the tooth to the rear of said face being tapered and defined by two plane surfaces passing through the shearing edges respectively and intersecting with the plate surface at a common point in a plane normal to and passing through the center of said leading face to promptly relieve the action on both sides of said leading face following shearing engagement of said cooperating faces and to avoid rubbing of the material between the bodies of said teeth.

3. A rotatable substantially flat plate for use in an attrition mill and the like in conjunction with a similarly formed opposite plate and adapted to produce a granulating and shredding action with reduced friction and rubbing contact comprising teeth projecting from the face of said plate and spaced thereover in predetermined radial and angular positions from an inner part substantially to the outer peripheral edge thereof, adjacent teeth both radially and in the direction of rotation of the plate being spaced apart a substantial distance such as to avoid filling up of the plate with the material being treated, each tooth having a substantially triangular-shaped leading face with its base upon the sur-

face of the plate and extending upwardly substantially normal to the plate and having a centrally located apex and adapted to have predetermined interfitting engagement with similar teeth on the cooperating plate forming substantially parallel shearing edges along both sides of said face having substantially uniform spacing therealong, the body of the tooth to the rear of said face being tapered and defined by two planes extending from said shearing edges to a common point rearwardly thereof and centrally located with respect to said leading face to relieve the action upon both sides of the tooth following shearing engagement of said cooperating faces and to avoid rubbing of the material between the bodies of said teeth.

4. A rotatable substantially flat plate for use in an attrition mill and the like in conjunction with a similarly formed opposite plate and adapted to produce a granulating and shredding action with reduced friction and rubbing contact comprising teeth projecting from the face of said plate and spaced thereover in predetermined radial and angular positions from an inner part substantially to the outer peripheral edge thereof, each tooth having a substantially triangular-shaped leading face with its base upon the surface of the plate and extending upwardly substantially normal to the plate and having a centrally located apex and adapted to have predetermined interfitting engagement with similar teeth on the cooperating plate forming substantially parallel shearing edges along both sides of said face having substantially uniform spacing therealong, each tooth having a short wearing surface of the same shape as and extending rearwardly of said face of limited extent in relation to the length of the tooth and adapted to prolong the maintenance of shearing edges on said tooth, the body of the tooth to the rear of said face being tapered and defined by two planes extending from said shearing edges to a common point rearwardly thereof and centrally located with respect to said leading face to relieve the action upon both sides of the tooth following shearing engagement of said cooperating faces and to avoid rubbing of the material between the bodies of said teeth.

5. A plate for use in an attrition mill and the like in conjunction with a similarly shaped opposite plate and adapted for the shredding of material supplied thereto with reduced rubbing and frictional development of heat comprising teeth projecting from the face of said plate having predetermined radial and angular spacing thereover, each said tooth being defined by two leading tapered surfaces intersecting each other extending rearwardly and upwardly toward a cutting face, said cutting face being defined by two angularly related straight lines lying in a plane substantially normal to the face of the plate and forming shearing edges with similar edges of a cooperating tooth, each tooth having a short wearing surface of the same shape as the cutting face extending rearwardly of said face a limited distance in relation to the length of the tooth and adapted to prolong the maintenance of a shearing edge on said tooth, the body of said tooth to the rear of said face being tapered to promptly relieve the rubbing action following shearing engagement of said shearing faces, and to thereby avoid development of frictional heat.

WILLIAM F. HALL.