

Jan. 21, 1941.

M. J. STACOM

2,229,141

HIGH PRESSURE ROLLER MILL

Filed Dec. 11, 1936

4 Sheets-Sheet 1

Fig. 1.

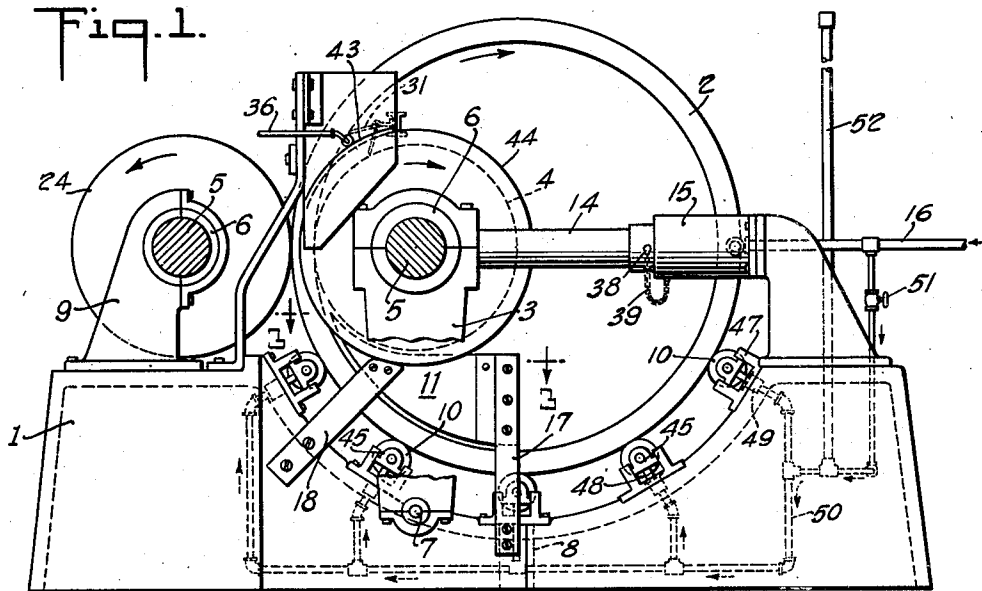


Fig. 2.

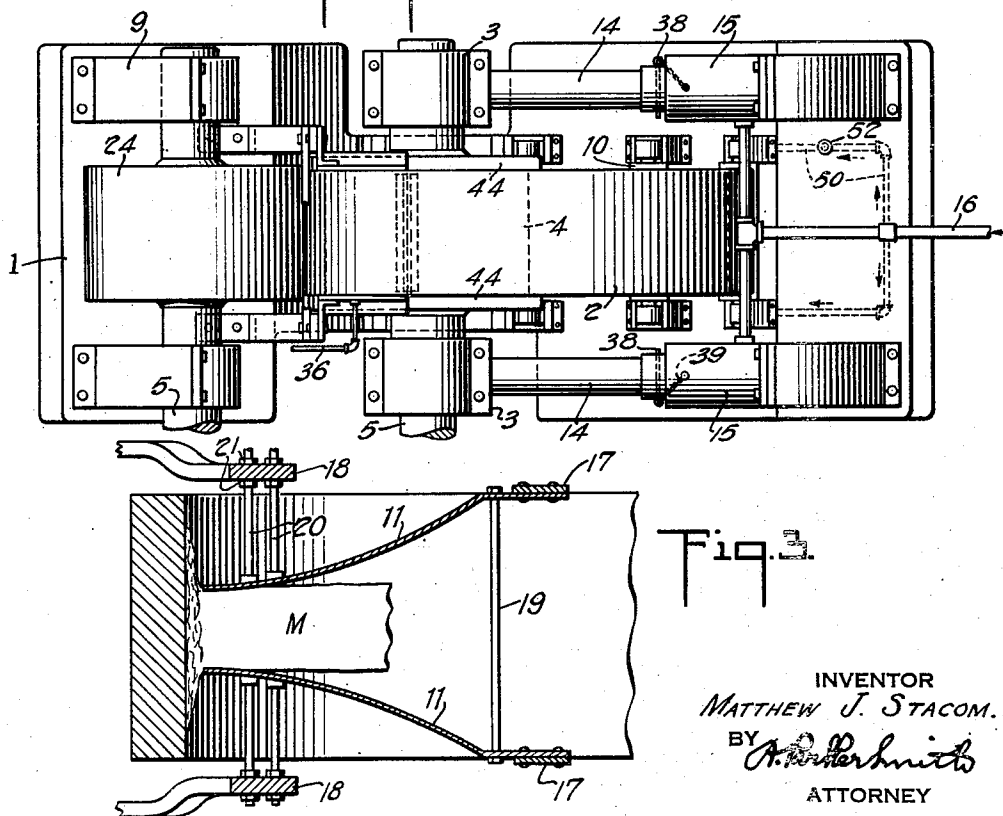


Fig. 3.

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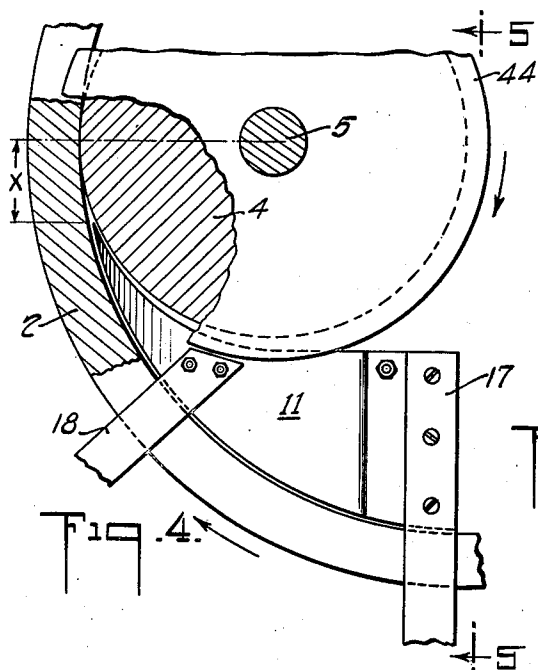
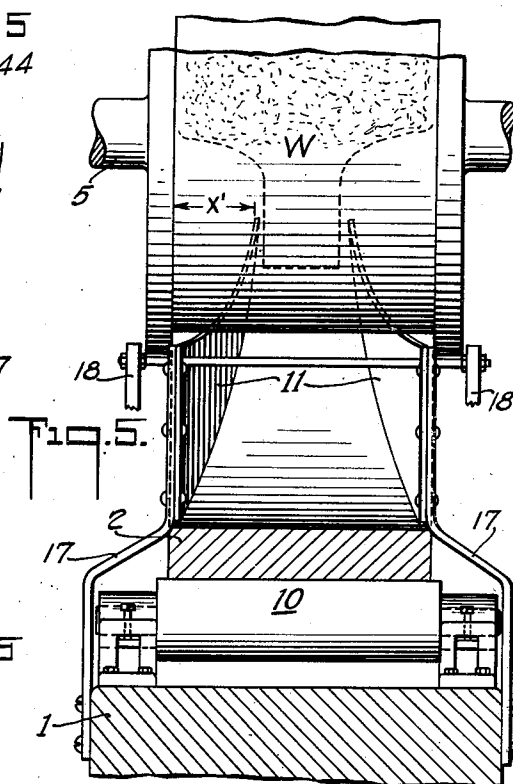
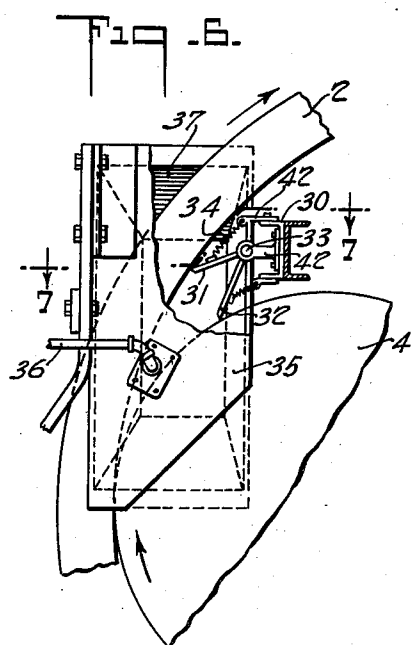
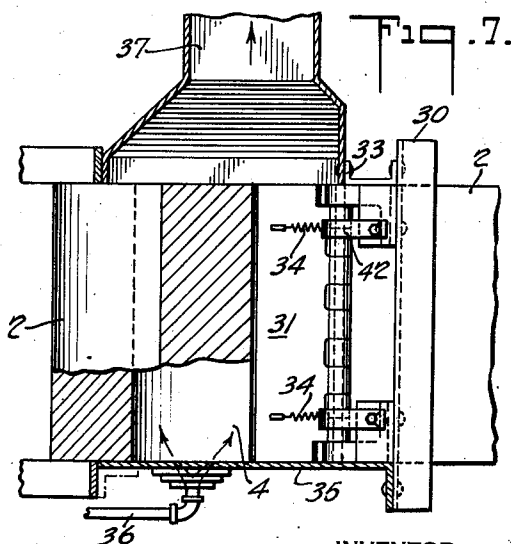
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4 Sheets-Sheet 2



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Fig. 8.

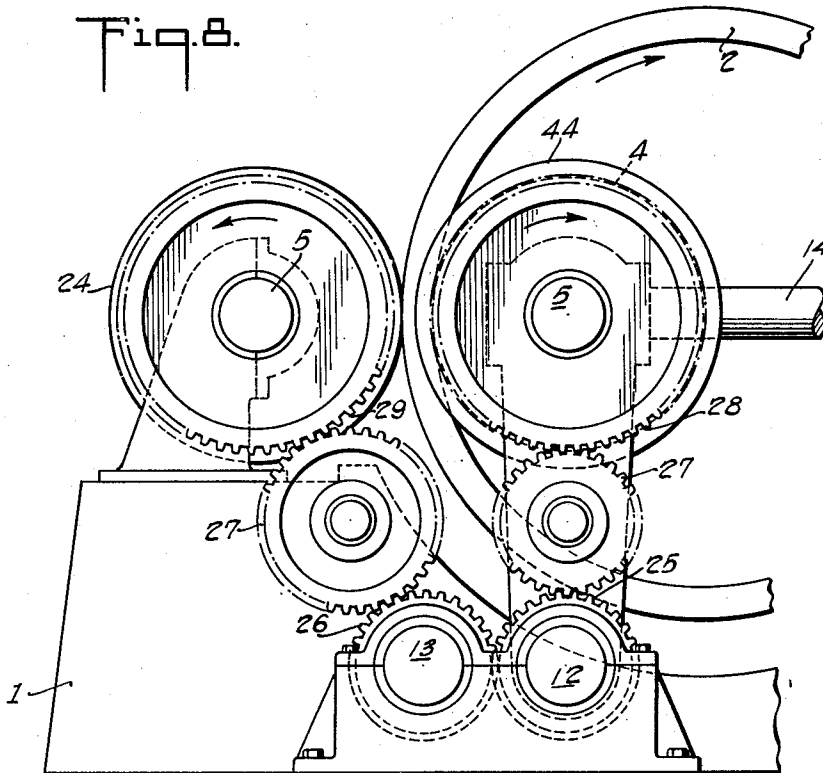
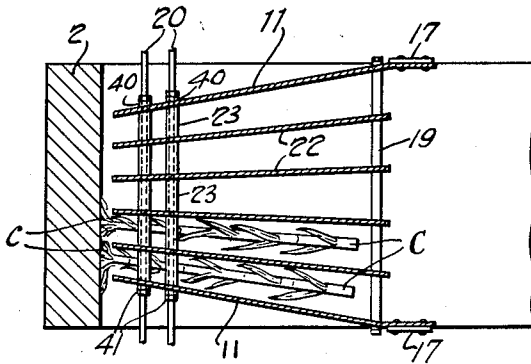


Fig. 9.

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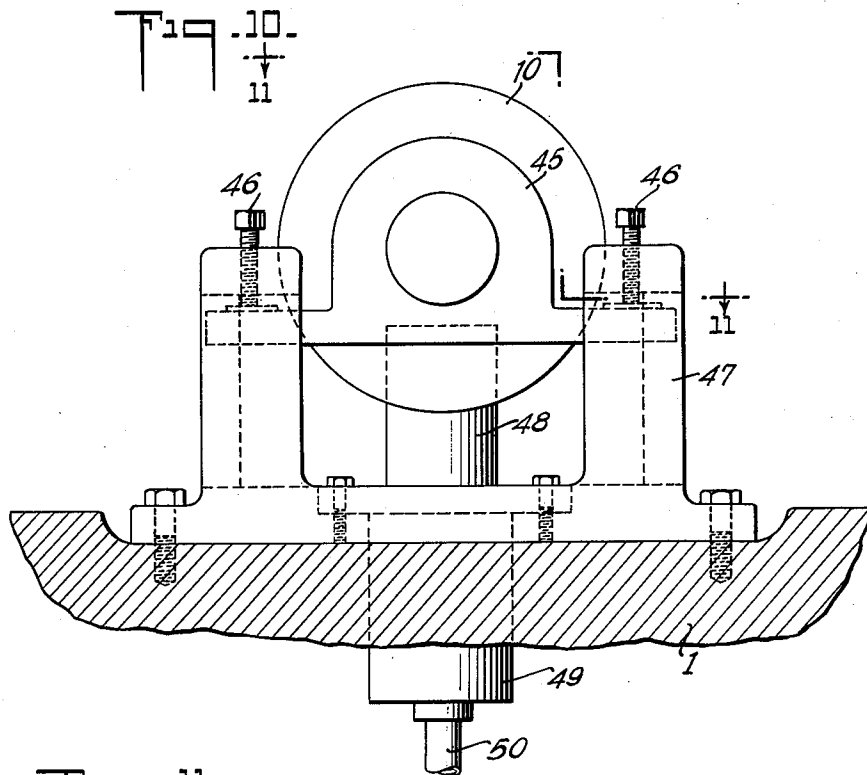
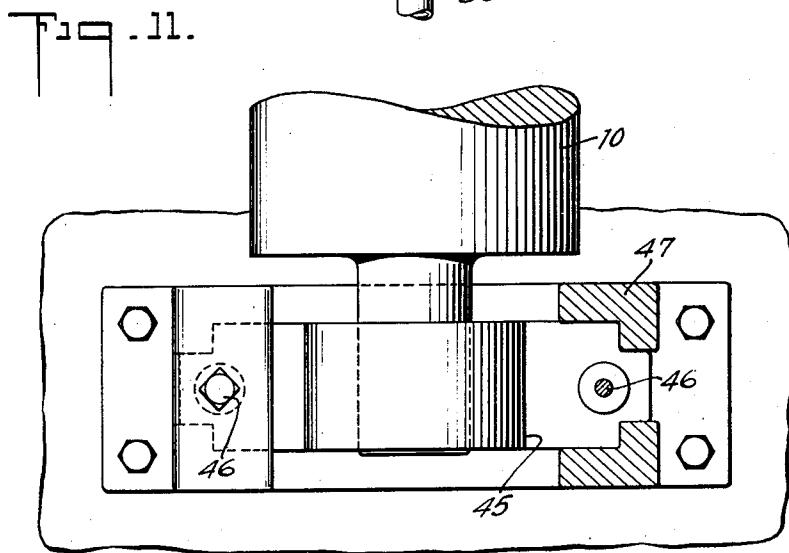
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4 Sheets-Sheet 4



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2,229,141

HIGH PRESSURE ROLLER MILL

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Application December 11, 1936, Serial No. 115,324

8 Claims. (Cl. 100—47)

This invention relates to apparatus for substantially dehydrating, disintegrating and comminuting by the simple application of tremendous pressure, natural cellulose-bearing substances such as wood, various vegetable growths, and similar materials. It more particularly relates to the type of roller mill shown and described in my pending application Serial No. 98,208, filed August 27, 1936, and also in the Allen patents Nos. 2,196,650 and 2,196,651. The apparatus here shown is particularly designed for use in carrying out the method described and claimed in my above noted prior application and embodies certain improvements on the apparatus there shown, and in said Allen applications.

The main object of the present invention is to provide certain improvements in means for handling the dry fragments and particles of the crushed masses when removing them from the mill.

The best form of apparatus embodying my invention at present known to me, together with one minor modification thereof are illustrated in the accompanying four sheets of drawings in which—

Fig. 1 is a side elevation of the machine with parts broken away and driving gear removed for clearness.

Fig. 2 is a plan view of the parts shown in Fig. 1.

Fig. 3 is a detail substantially horizontal section on irregular line 3—3 of Fig. 1, which passes under the interior roll.

Fig. 4 is a detail side elevation on an enlarged scale and with parts broken away and others shown in section, illustrating more clearly the configuration of the roll pass and the guides for material to be delivered thereto.

Fig. 5 is a vertical cross section on line 5—5 of Fig. 4.

Fig. 6 is a detail side elevation with parts broken away and others shown in section illustrating the attachment for removing the crushed materials from the delivery side of the roll pass by air currents, the flanges on roll 4 being omitted.

Fig. 7 is a substantially horizontal section on irregular line 7—7 of Fig. 6.

Fig. 8 is a detail side elevation of a portion of the machine on a larger scale than that of Fig. 1 and showing the preferred form of gearing.

Fig. 9 is a detail section similar to Fig. 3 showing a multiple set of guides for the materials being fed to the roll pass.

Fig. 10 is an enlarged detail side elevation of

one of the anti-friction rollers supporting the floating ring element of the mill, parts being broken away and others shown in section, and

Fig. 11 is a similar plan and partial sectional view of the same on the line 11—11 of Fig. 10.

Throughout the drawings like reference characters indicate like parts.

Referring to Figs. 1 and 2 the general construction of the machine there shown is similar to that shown in my co-pending application Serial No. 98,208 hereinbefore noted and comprises the base frame 1 on which is mounted the freely revoluble, hard steel ring 2, carried by the anti-friction rollers 10, 10, the interior roll 4 of much less diameter than the ring, and the exterior roll or anti-friction roller 24 journaled in the housing 9 carried by the base frame. The roll 4 is journaled in the swinging housing 3 pivoted on the main frame at 7 and said housing and roll can be forced toward anti-friction roller 24 by the pistons 14, 14, reciprocating in hydraulic cylinders 15, 15, to which water or other fluid under very great pressure is supplied through the inlet pipes 16 shown in Fig. 2.

A drain outlet is indicated at 8 in Fig. 1 through which any liquid expressed from the material passing through the mill may be collected in any suitable receptacle not shown.

On account of the great pressures used it is necessary to have oilless bearings 6, 6 for the journals of shaft 5, 5, carrying rolls 4 and 24 since under the pressures employed the usual lubrication by oil is not practicable, even the heaviest oil being expelled from between the opposing surfaces of journal and bearing. These oilless bearings are of the kind now common in the art and consist of two-part bronze bushings having numerous small radially disposed perforations, each of which is packed with graphite. As soon as rotation of the journal begins a film of graphite is formed on the surface of the bearing and this persists almost indefinitely if the surfaces are not scratched or otherwise disturbed.

44, 44 are flanges on the ends of roll 4 which fit closely against the sides of ring 2 and serve to guide the latter during its revolution, while also preventing escape of material from the pressure zone.

Mechanism is provided for rotating the three revoluble elements 2, 4 and 24 in the directions shown by the arrows in Fig. 1 and preferably this consists of the trains of gearing shown in Fig. 3 where 12 indicates the main driving shaft connected by idler gear 27 to the gear wheel 28 on the shaft of roll 4 and 13 indicates another shaft

carrying gear wheel 26 which meshes with gear 25 so as to be driven thereby and also meshes with another idler 27 which transmits motion to gear wheel 29 on the shaft of idler roll 24. When the mill is in operation rolls 4 and 24 are forced by hydraulic pressure toward or against the inner and outer faces of roll 2, or said ring 4 is pressed against a layer of material being carried upward by the inner face of said ring. In either case ring 2 is frictionally driven around on its mathematical axis while supported and guided by rolls 4 and 24 and by anti-friction rollers 10, 10.

The pins 38, 38 (Figs. 1 and 2) are provided for the purpose of inserting in holes extending crosswise of the hydraulic plungers 14, 14, to limit the latter's backward motion when the pressure is taken off the hydraulic system to permit the surfaces of ring and rolls to be slightly separated for any purpose, or to relieve the parts from strain when not in use.

Such limitation of backward movement of the plungers helps to conserve the pressure fluid since a larger portion of it is then left in the cylinders during the periods while the rolls are not operating, and this can be used again when the application of pressure is resumed. 39, 39 are little chains to which the pins 38 are attached to prevent their being lost or carried away when not in use.

As it would be a difficult job to exactly locate all journal bearings for anti-friction rollers 10, 10, so that each would support its share of the weight of ring 2 and thereby hold it firmly and accurately in any desired position, I prefer to mount the journal bearings 45, 45 for said rolls loosely in housings 47, 47 as shown in Figs. 10 and 11 and to loosely support each one of said bearings on a ram 48 in a hydraulic cylinder 49 properly disposed in the main frame 1, and then provide adjustable stops 46, 46, against which the laterally projecting lugs of the journal bearings can be pressed by the ram as shown in Fig. 10. The pressure fluid in cylinders 49, 49, could be supplied from any available source through an interconnected system of pipes 50, 50 (see Figs. 1 and 2), but such piping can be conveniently connected to the main pressure pipe 16 as indicated in Fig. 1. If that is done there should be some kind of an air pressure chamber such as indicated at 52 connected to the system of piping and there should be a cut-off valve 51 which could be closed after the pressure on rams 48 has been adjusted. The apparatus last above described in effect creates a hydraulic roller cradle for ring 2.

Ring 2 being open at the sides, any material on which the roller mill is to operate may be introduced into its interior by hand and deposited on the lower inner surface thereof, or any desired automatic feed (not shown) may be employed for that purpose.

If desired the train of gearing 13, 26, 27 and 29 may be omitted and the power for producing the desired rotation of the parts would then be positively applied to roll 4 only, ring 2 and roll 24 being both frictionally driven. In such case roll 24 may have any desired diameter, but if both 4 and 24 are positively driven by gearing, as here shown, the diameter of roll 24 preferably should be enough larger than that of 4 to give 24 the same peripheral speed as that of the outer surface of ring 2, when 4 and 24 are positively driven at the same R. P. M. and there is no slipping of 2 on 4. This proportioning of the roll diameters

is indicated in Fig. 8. On the other hand, if 4 and 24 have equal diameters the gearing should be so designed as to increase the R. P. M. of 24 over those of 4 sufficiently to effect the same result of equalizing its peripheral speed with that of the outer surface of ring 20.

11, 11 represent curved guide plates of half-crescent shape supported in vertical position by brackets 17, fastened to their broad, rear ends, and brackets 18 supporting rods 20 which are welded or otherwise fastened to said plates 11, 11, near the smaller ends of the latter. Brackets 17 and 18 are mounted on the base frame 1, and 19 indicates a spacer rod for maintaining the rear ends of the plates accurately spaced apart.

These guide plates are generally similar to those indicated at 11 in Figs. 1 and 3 of my above mentioned copending application, but are curved or inclined one toward the other more sharply so as to laterally restrict to a greater extent the path of the material being carried by ring 2 toward the pressure zone, or to closely guide the feed movement of any narrow strip of wood such as is indicated in broken lines at W in Fig. 5 of the drawings herein. The guiding action on a ribbon of loose material is indicated at M in Fig. 3. In all cases the material will be delivered at a point midway laterally of the pressure-producing area.

The distance X indicated by the short arrows in Fig. 4, from the apex of either guide plate 11 to the line which marks the locus of maximum pressure on any strip of wood or of other material passing through the rolls, should preferably be not greater than the distance X' from the apex of either guide plate 11 to the nearer edge of ring 2, as indicated by the short arrows in Fig. 5. This will make sure that no rear end of a narrow strip of wood being crushed in the mill will swing beyond said ring side edge, even if the flanges 44 here shown on roll 4 have been omitted.

These flanges 44 serve a double purpose since they prevent any laterally expressed material (such as indicated in Figs. 3 or 5) from being squeezed out beyond the pressure zone and also guide the revolution of the floating ring 2, preventing it from shifting axially under any conditions which might tend to cause it to creep toward one side or the other.

Fig. 9 illustrates a modified guide attachment for the mill which is particularly designed for handling cornstalks, sugar cane and similar vegetation growing in long stalks, so as to feed them to the pressure zone endwise, and always substantially parallel one to another, as indicated at C, C. In this modification, a plurality of guide plates 22, 22 are supported in substantially vertical positions between the outer plates 11, and are inclined thereto and to one another so as to form a plurality of channels all tapering and converging toward the roll pass.

Preferably these channels should be so designed with reference one to another for use with any particular material in the form of stalks that the portions of such stalks laterally expressed from any one of them in or near the zone of maximum pressure will merge with, but not seriously overlap on, the others, as indicated at c, c. The intermediate guide plates 22, 22 may be of the same shape as the outer ones 11, 11, and their rear, broader, ends may be supported on the rod 19. Their forward ends may be supported on the rods 20, 20, which in this case should extend from one bracket 18 to the other and may have short sleeves 23, 23 strung on them to properly space 75

apart all these plates. The assembly so formed would preferably be held together by nuts 41, 41, and tapered washers 40, 40.

Figs. 6 and 7 show more in detail a preferred form of means for removing the crushed materials coming from the discharge side of the pressure zone. Nearly all the cellulose-bearing natural products and substances of similar degrees of hardness are so thoroughly disintegrated and dehydrated by the pressure applied to them in this apparatus that the crushed material can easily be removed by an air blast, and a mechanism of that kind is here shown comprising the compressed air pipe 36 which discharges through side plate 35 in a direction such as to cause a jet of air to blow across the space between ring and roll surfaces.

Some of the crushed material usually adheres to the surfaces of the ring or roll or of both, and to remove this adhering material and also to form with said plate and surfaces a partly enclosed space I have shown two knives 31 and 32 hinged together at their backs on rod 33 which is supported on brackets 42, 42, carried by the cross bar 30. Tension springs 34 hold the edge of the upper knife or scraper 31 against the surface of ring 2 and that of the lower one 32 against the surface of roll 4.

When roll 4 has flanges 44, plate 35 should have an offset portion to fit over one of such flanges and this arrangement can be secured by having an arcuate crease such as indicated at 43 in Fig. 1 in said plate. For simplicity the roll flanges are omitted from the portions of the roll 4 shown in Figs. 6 and 7 and in such case a flat plate can be used as is there shown.

To collect the material blown out of the mill by the apparatus last above described, I may provide a suction head or conduit 37 (shown in Figs. 6 and 7 but omitted from Fig. 2), the edge walls of the mouth of which are closely adjacent the end of roll 4, the side edge of ring 2, and the ends of knives 31 and 32, thus forming a substantially enclosed space on the discharge side of the pressure zone from which the fine particles and fibres of disintegrated wood or other vegetable materials can be air borne to any suitable collector, cyclone separator or other receptacle, not shown.

In adjusting the machine for operation on a given material sufficient fluid pressure should be admitted to cylinders 49 to raise ring 2 to exactly the desired position, valve 51 then closed so as to hold the parts in their adjusted positions while each screw stop 46 is brought to a bearing on the journal bearing member 45 beneath it, and valve 51 thereafter opened enough to allow the inflowing fluid to rise in the air chamber 52 sufficiently to produce a compressed air pressure that will set all the journal bearings firmly against stops 46. Thereafter said valve should be closed and kept closed until another setting of the parts is desired because of a change in the materials to be operated upon, or because of a drop in pressure having resulted from leakage past packings or from other causes.

In operating the mill under a hydraulic pressure of 2,000 pounds per square inch and upwards in the cylinders 15, 15 (which are each 4½ inches in diameter), strips of pine, fir, and similar woods, green or soaked with water and one-quarter inch thick, are crushed and extruded laterally while passing through the pressure zone in the general manner indicated by the broken lines in Fig. 5. Each such strip is thus

reduced to a loose, fragile, friable mass of its constituent fibres which have been sufficiently separated for use in paper making machinery directly for certain purposes, or after relatively simple and inexpensive chemical treatment in the manufacture of excellent grades of paper.

Green cornstalks, or dried one which have been soaked in water, when fed to the pressure zone as indicated at C, C, in Fig. 9 are similarly crushed and expressed laterally as indicated at 10 c, c. The entire product of this character derived from wood or waste garden vegetation run through this mill can be immediately put through a hammer mill in air suspension and reduced to a fineness of about 80 mesh in one operation usually.

In both the case of wood and of cornstalks nearly all the saps or other contained liquids are expelled, and the remainder will evaporate rapidly on exposure to the air at room temperature. This practically frees the product from particles which if present would be softened into sticky condition by the heat in a hammer mill and gum up the screen.

In both cases the amounts of original ether-soluble contents are found to have been sharply reduced by the milling operation.

If a loose mass of fibrous and granular material of vegetable origin is fed to the rolls in a narrow ribbon as indicated at M in Fig. 3, similar lateral expansion or expression results in the pressure zone but to a less degree than in the case of solid material like wood.

The principal advantage realized from placing the flanges 44 on roll 4 in a mill of this description results from the fact that said flanges travel circumferentially along the side edges of the pressure zone at substantially the same speed as do the portions of the edges of the ring 2 which are in contact with them, and similarly at the same speed as do any compressed portions of material which may be jammed against them while passing between said ring and roll. Consequently there is no frictional drag exerted by the side edges of such compressed masses of material on said flanges. On the other hand, if such highly compressed material was jammed against stationary side plates installed to prevent its escape from the pressure zone, much friction would result with consequent waste of power and wear on the parts.

When operating on wood and other vegetable materials of light weight the crushed and pliable masses discharged upwardly from the pressure zone between ring and roll, or scraped from the latter, are easily blown or sucked out of the mill by any suitable blower or vacuum apparatus such as indicated in Figs. 6 and 7, and hereinbefore described.

Various changes could be made in the particular construction of the guiding means employed, or in the rotary pressure producing mechanism used in carrying out my improved procedure without departing from the underlying principles of the invention as hereinbefore explained or as defined in the appended claims or some of them.

No claim is made herein to the provision of means for allowing the ring to dip upon introduction of material into the pressure zone, since that feature is claimed in my copending application Serial No. 253,202. Also, no claim is made herein to the various methods referred to or to their application to particular materials, since these features are claimed in my copending ap- 75

plication Serial No. 195,776, filed March 14, 1938, and in other copending applications.

Having described my invention, I claim:

1. In a roller mill, the combination of an annular ring, a roller, of smaller diameter than the interior diameter of the ring, positioned within the ring, means for forcing the ring and the roller toward each other, scrapers extending transversely of the ring adapted to bear upon the surface of the ring and the surface of the roller, and means for projecting a fluid jet into and substantially confined to the enclosure formed by the horn angle between the roller and the ring and the scrapers.
2. In a roller mill, the combination of an annular ring, a roller, of smaller diameter than the interior diameter of the ring, positioned within the ring and adapted to roll on or adjacent the surface thereof along a generally horizontal line, means for forcing the ring and roller toward each other, scrapers extending transversely of the ring and having surfaces adapted to bear upon the surfaces of the ring and roller, a plate adjacent an edge at one end of the said roller, ring and scrapes, and means for projecting a gas jet into and substantially confined to the enclosure between the scrapers and the horn angle between the surfaces of the roller and the ring.
3. An apparatus such as defined in claim 1 in which said jet projecting means comprises a pipe for compressed air located at one side of said ring and a plate extends along and in contact with the edges of said roll and ring from the pressure zone therebetween a considerable distance on the discharge side therefrom, one end of said pipe discharging through an opening in said plate.
4. An apparatus such as defined in claim 1 in which said jet projecting means comprises a pipe for compressed air located at one side of said ring; a plate extends along and in contact with the edges of said roll and ring from the pressure zone therebetween a considerable distance on the discharge side therefrom, one end of said pipe discharging through an opening in said plate; and a take-off conduit is provided, the intake end of which has its walls in contact with cor-

responding portions of the ring and roll edges on the side of the mill opposite said plate.

5. An apparatus such as defined in claim 1 in which said jet projecting means comprises a pipe for compressed air located at one side of said ring; a plate extends along and in contact with the edges of said roll and ring from the pressure zone therebetween a considerable distance on the discharge side therefrom, one end of said pipe discharging through an opening in said plate; and the said scrapers extend from the inner surface of said plate across and in contact with said ring and roll surfaces.

6. An apparatus such as defined in claim 1 in which said jet projecting means comprises a pipe for compressed air located at one side of said ring; a plate extends along and in contact with the edges of said roll and ring from the pressure zone therebetween a considerable distance on the discharge side therefrom, one end of said pipe discharging through an opening in said plate; the said scrapers comprise a pair of scraping knives extending at a normal from said plate between said ring and roll surfaces; and spring means are provided for holding the edge of one of said knives against the surface of said ring and the other against the surface of said roll.

7. In a roller mill the combination of a ring having a smooth imperforate inner surface, a roller having a smooth imperforate external surface positioned within said ring and adapted to roll upon the inner surface thereof along a generally horizontal line, smooth scrapers extending transversely of the ring and adapted to bear upon the surfaces of the ring and roller and to form an enclosure therewith, adjacent the discharge side of the high pressure zone, said enclosure having an outlet at one end, and means for directing a jet of compressed gas into and confined within the other end of said enclosure.

8. A roller mill, as defined in claim 7 including a conduit at the outlet end of said enclosure and a closure plate at the inlet end in contact with the ends of said scrapers.

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