

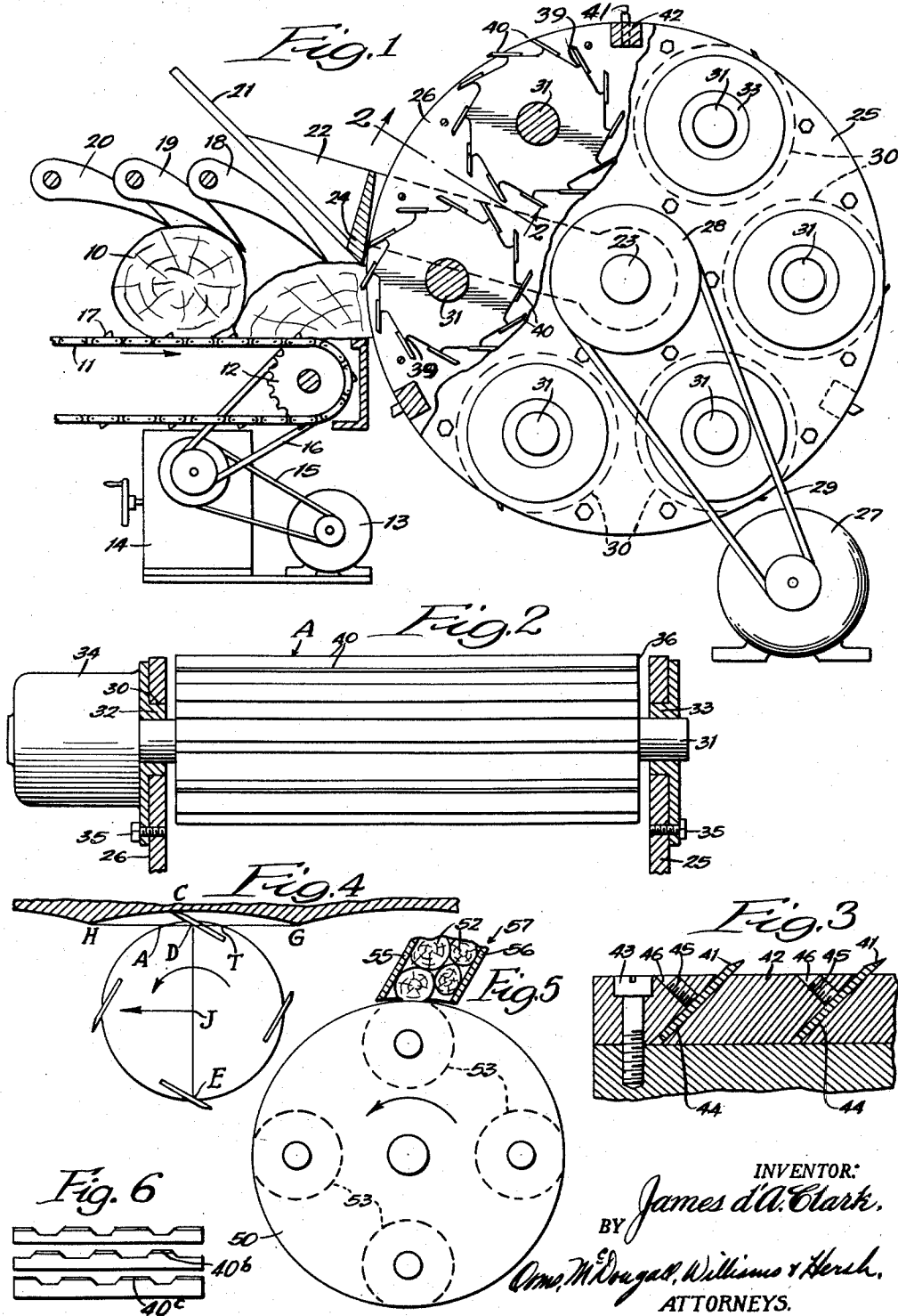
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APPARATUS FOR PRODUCING FIBROUS ELEMENTS

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APPARATUS FOR PRODUCING FIBROUS ELEMENTS

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This invention relates to apparatus for the production of wooden wafers adapted to be used in the manufacture of boards and panels by molding, preferably under heat and pressure, and its relates more particularly to improvement in apparatus for the manufacture of wafers of the type described from blocks of wood, scrap wood or other cellulosic composites, having at least two edges tapered, as by the method described in my copending application Ser. No. 78,692, filed on February 28, 1949, now Patent No. 2,655,189 of which this application is a continuation-in-part. In addition, the apparatus forming the subject matter of this invention can be used to produce fibrous elements of the type described in my copending application Ser. No. 344,089, filed on March 23, 1953 now Patent No. 2,773,789, issued December 11, 1956, which is a continuation-in-part of abandoned application Ser. No. 192,284, filed on October 26, 1950, with the improvement in that the wafers or elements can be formed with all four edges tapered.

As explained in the aforementioned application Ser. No. 192,284, when molded under heat and pressure in admixture with a small amount of additional resinous binder, the wafers having tapered edges transversely of the grain of the wood produce boards having higher strength and better appearance than boards molded of wooden elements of the types which had theretofore been produced. However, if the wooden elements or wafers are relatively thick, such as greater than 0.015 inch, and in the event that the wafers are formed of hard wood or wood which contains hard wood and semi-annular rings, as in most southern pines, then it is advantageous to make use of wafers which are tapered also along the edges parallel to the grain of the wood to the end that reduced pressure can be used to integrate the elements into a product of lesser weight per unit thickness but wherein, because of the taper all around the edges of the wafers, the wafers are still able to merge into the faces of tapering elements to produce a stronger board and a smoother and better appearing surface.

Briefly described, the apparatus used in the preparation of wafers in accordance with the aforementioned application Ser. No. 78,692, consists of a horizontal table which rotates continually about a vertical axis and which carries on its surface one or more cutting cylinders that rotate about a horizontal axis independently of and at the same time as the table and which also carries one or more radially mounted scoring discs which extend forwardly from the surface of the table. The hoppers containing the wooden blocks for cutting into wafers are radially arranged above the horizontal table whereby the ends of the blocks adjacent the surface of the tables are engaged by the cutting edges of the knives and by the scoring elements. With an arrangement of the type described, the elements cannot be formed with tapered side edges unless the vertically disposed scoring discs are replaced with fixed knives mounted at a transverse angle so as to score the wood in a manner to define and form the taper

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for the side edges when the wafers are severed from the block.

Substitution of fixed knives angularly arranged is objectionable because of the disturbing effect which they will have on the wooden blocks in the hopper since the blocks will have a tendency to be displaced by the fixed scoring members and will tend to cause lateral shifting movement of the blocks within the hoppers since an arcuate rather than a straight series of parallel scores of cuts are made with the horizontal waferizing machine. As a consequence, it is preferred to achieve the production of wafers having tapered side edges by scalloping or staggering the main cutter knives, such as described in the aforementioned application Ser. No. 192,284. Even then the elements cut from the extremities of the pieces of wood, that is the portion adjacent the leading and trailing edges of the hopper nearest the center of the disc, will be severed at an appreciable angle, say over 15°, to either direction of the grain or in the direction at right angles to the grain by reason of the arcuate path of the cutting knives. Consequently, unless the disc is made of unduly large diameter, such wafers have been found to be unduly weak and less desirable for use in the molding of composite boards and panels.

In the apparatus described in applications Ser. No. 192,284 and Ser. No. 344,089, which is used for the manufacture of wafers having tapered edges, no means are provided for limiting the lengths of the elements in the direction of cut except by way of limiting the thickness of the wooden slabs fed into the machine for waferizing. In the event that the elements are to be produced from scrap logs and thick pieces of wood waste, it becomes necessary to cut the wood into slabs of the thickness corresponding to the maximum length desired in the wafers, which is generally less than 5 inches and generally from 0.5 to 2 inches. This preliminary step accounts for waste of equipment, labor and wooden material. In addition, means are not available in equipment of the type described for providing the desired taper at the edges of the elements formed at the beginning and at the end of each.

It is an object of this invention to produce a new and improved apparatus for making fibrous elements or wafers with tapered edges and it is a related object to produce apparatus of the type described which yields wafers independent of the shape or thickness of the wooden slabs fed thereto for waferizing.

Another object is to provide a waferizer of the type described for cutting such elements from wood, either parallel to or at right angles to the grain of the wood.

A further object is to provide apparatus of the type described which produces wafers having tapers on both its side and front and back edges.

A still further object is to provide a waferizer of the type described which is simple in construction and easy in operation for use in the conversion of wood waste and wooden blocks in an economical and efficient manner into wooden elements which can be used in the manufacture of rigid boards, panels and the like molded products having high strength and excellent appearance and without the addition of substantial amounts of additional binder.

These and other objects and advantages of this invention will hereinafter appear and for purposes of illustration, but not of limitation, an embodiment of the invention is shown in the accompanying drawing in which:

Figure 1 is a sectional elevational view of a waferizing machine embodying features of this invention;

Figure 2 is a fragmentary view in sectional elevation taken along the line 2—2 of Figure 1 illustrating the construction and operation of a cutting head of the type illustrated in the machine of Figure 1;

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Figure 3 is a partial sectional view taken through a portion of Figure 1 and illustrating a scoring means;

Figure 4 is a diagram which illustrates the improvement of a cutter blade to sever a wafer from the wooden block with apparatus embodying features of this invention;

Figure 5 is a sectional elevational view illustrating a modification in a waferizing machine embodying features of this invention, and

Figure 6 is a plan view showing a modified form of cutting blade which may be employed in the practice of this invention.

Briefly described, invention resides in an apparatus comprising a pair of disc plates mounted on a shaft to form a large spool which supports a plurality of individually driven cylindrical cutting heads on the periphery thereof in position to engage the faces of pieces of wood in the form of wooden blocks or the like fed in the direction towards the cutting elements. The thickness of the elements cut depend on the rate of feed and the spaced relation of the cutting elements in the cylindrical cutting head as well as the rotational speed of the cutting heads. The width of the elements, as measured by the distance perpendicular of the plane of Figure 1, is controlled chiefly by the spacing of the scoring knives, as shown in Figure 3, or by the length of the scallops in the edges of the main cutter knives, or by the individual lengths of the cutter knives in the event that the knives are staggered. The length of the elements produced will be determined by the diameter of the cutter heads, by the thickness of the elements cut and by the relative peripheral speed of the spool carrying the cutter heads and the peripheral speeds of the revolving heads as discussed in the parent application Ser. No. 78,692.

Referring now to the drawing for a more specific description of a waferizer embodying features of this invention, wooden slabs such as the logs 10, scrap wood or the like are advanced forwardly at a constant speed for cutting on a conveyor, such as an endless feed chain 11 operating about sprockets 12 driven by a motor 13. A variable speed drive 14 is interposed and is operatively connected to the driven sprocket 12 and to the driving motor 13 by chains 15 and 16 to provide adjustment for speed to vary the thickness of the wafers cut from the pieces of wood. Lugs or teeth 17 are provided on the endless feed chain 11 for positive engagement to advance the pieces of wood 10 on the surface thereof into feeding relation with the cutting knives, which will hereinafter be described. The upper surfaces of the pieces of wood are engaged when advanced to the cutting areas by one or more hold-down dogs 18, 19 and 20 of variable length and which are mounted for pivotal movement about spaced centers for free swinging movement to permit advancement of the wooden pieces thereunder but angularly positioned to resist displacement of the wooden pieces backwards while in the area to be engaged by the cutting knives. An additional hold-down dog 21 is supported on spaced arms 22 mounted on the shaft 23 forming the axis about which the spool or disc plates are rotated and the hold-down dog 21 is angularly arranged so that its inner edge 24 is continually a very small fixed distance from the locus of the periphery of the cutter heads.

The cutting device comprises a pair of laterally spaced and vertically disposed disc plates 25 and 26 fixed on opposite ends of shaft 23 for conjoint rotational movement as a spool. The shaft is supported at its end portions extending beyond the disc plates in suitable journal boxes (not shown) held in fixed position on standards. Rotational movement is imparted to the shaft 23 and conjointly to the disc plates mounted thereon by a driving motor 27 connected to a sprocket 28 on the shaft by means of a chain or belt 29. It will be understood that other means for rotating the shaft and disc plates may be employed, such for example as gear means connecting the shaft with the motor, with or without an intervening reduction gear box to vary speed of rotation.

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One or more openings 30 are provided in the peripheral end portions of each disc plate in alignment with each other for purposes of mounting a cutter head, indicated by the letter A, therebetween. For purposes of balance and to secure greater production, it is preferred to employ more than one cutter head and to equidistantly space the cutter heads about the periphery of the disk plates, such for example as the six cutter heads mounted on the disk plate, as illustrated in Figure 1.

As illustrated in Figure 2, each cutter head A includes a shaft 31 extending laterally across the space between the disk plates through the openings and into bearings 32 and 33 secured to the side walls of the plates in registry with the openings. The shafts may be actuated in their respective bearings for rotational movement independent of the disk plates by gearing fixed to the end of the shafts and to the main shaft 23, or as shown, by individual motors 34 mounted on a portion of the same shaft extending beyond its bearings. It is desirable to provide means for radial adjustment of the shafts as through the bearings to enable more perfect alignment of the shaft circumferentially about the disk plates, as by means of radially extending slots either in the disk plate or bearing, and means such as bolts and nuts 35 for securing the elements in their adjusted position.

The cutter head which is mounted on the shaft for rotational movement therewith between the disk plates comprises a cylindrical member 36 formed of metal, such as steel, having a plurality of slots or gullets 39 preferably arranged in equally spaced apart relation about the periphery of the cylinder and extending angularly into the cylinder from the peripheral surface thereof, such as at a preferred angle of about 30° to the tangent of the cylinder. In the preferred form, the slots extend continuously across the cylinder for receiving an elongate cutter blade 40 in fixed relation within each slot. The blades are slotted for operative engagement of the securing screws, and the blade can be adjusted outwardly for proper alignment or for increasing the protrusion of the cutting edge.

When the cutting blades 40 fixed in the cylinder 36 and extending continuously across the cylinder are formed with scallops or of a series of short blades 40b in spaced apart relation and staggered with the blades 40c of adjacent sets of knives, the width of the blades and the spaced relation between the blades transversely of the cylinder will determine one dimension of the fibers cut—the width. Under such circumstances, however, the usable cutting area is reduced by one-half and it is preferred, for more efficient use, to make use of cutter blades which provide a cutting surface extending continuously across the cylinder and to rely upon scoring knives 41 to engage the surface of the wooden pieces in advance to score the wood to depths slightly greater than the thicknesses to be cut by cutting knives which engage the wood in advance of the next scoring member. The lateral spacing of the scoring knives then determines the width of the wafers severed from the block.

As illustrated in Figure 3, the scoring blades 41 are mounted in a bar 42 fixed, as by screws 43, in notches provided in the periphery of the disk plates 25 and 26 to extend between the disk plates. Slots 44 are provided in laterally spaced apart relation through the bar for insertion of the scoring knives 41 to extend the cutting edges at an acute angle of about 20–50° and preferably about 30° to a predetermined distance beyond the periphery of the disk plates and by a distance which is at least equal to and preferably greater than the thickness of the wafers to be cut. The scoring members are fixed in adjusted position by means such as a setscrew 45 operating through threaded openings 46 in the bar 42 for engagement with the shank of the scoring elements. It is preferred to make use of a bar supporting a plurality of spaced apart scoring elements for every

pair of rotary cutting heads, but more or less may be used with the corresponding depth of score.

In operation, the disc plates are adapted to be rotated by the motor 27 in a counterclockwise direction in Figure 1, that is in a direction to bring the cutter heads down onto the wooden pieces from above and the cutting cylinders mounting the cutting blades are also rotated independently of the disc plates in a counterclockwise direction so that the movement of the blades relative to the piece of wood will constitute the sum of the peripheral speeds of the disc plate and the cutting cylinder. The revolving cutters sever elements from the face of the wooden pieces advanced to their locus. The thickness of the elements cut may, if desired, be varied by adjusting the rate of feed as determined by the linear speed of the feed chain.

The elements severed by the cutting knives of the cutter heads are discharged tangentially downward into a suitable receiver or upon a suitable conveyor (not shown) positioned therebeneath. In the alternative, other means for feeding wooden pieces to the apparatus may advantageously be employed particularly when the pieces of wood being fed are of small dimension and modification in an apparatus of the type described is diagrammatically shown in Figure 5.

In this modification, the disc plate carrying cutters as described in Figure 1 is enclosed about its periphery to form a drum 50 which functions as the under support for a hopper into which pieces of wood 52 are fed. In this modification, the cutter head of the type described is entered sideways in a substantially cylindrical recess 53 in the drum and it is assembled and secured by bolts to the disc plates 25 and 26, as in Figure 1, but in such position that the cutting blades extend beyond the surface of the drum by an amount equal to the thickness desired in the elements. When an element is cut from a piece of wood, it will be contained in the gullets 39 in advance of each knife and swept around the cylindrical recess 36 for discharge by centrifugal action. It has been found desirable, in a construction of the type described, to incline the front and back walls 55 and 56 of the hopper in the forwardly direction, as shown. By so doing, the cutting force of the knives operates to wedge the wooden pieces in the front of the hopper so that the surface of the cylinder not only functions to hold the wooden elements stationary but the slope reacts in assistance to gravitational force in feeding the wooden pieces into engagement with the cutting knives for wafering. In the alternative, auxiliary pressure means such as pressure feet or caterpillar chains, commonly used in apparatus for wet grinding of wood in the manufacture of pulp fibers, may be used to advance the pieces of wood positively and uniformly into cutting relation with the knives on the cutter cylinder.

For the manufacture of fibrous structures of low density, such as acoustical tile and the like, it is desirable to cut the fibrous elements with knives having their edges held across and moved parallel to the grain of the wood. For denser structures, such as are described in the copending application Ser. No. 94,812, filed on May 23, 1949, now Patent No. 2,689,092, or in the copending application Ser. No. 192,284, filed on October 26, 1950, it is desirable to cut the elements with the cutting blades parallel to and across the grain of the wood.

By way of illustration of conditions for operation, it is desirable to rotate the disk plates at a peripheral speed which is preferably at least one-fifth the peripheral speed of the cutter heads. The latter preferably should have a peripheral speed in excess of 3,000 feet per minute. As shown in Figure 2, this may conveniently be accomplished by attaching the cutting cylinder directly to a motor 34. If the cylinder head is 10 inches in diameter and rotated at 1750 revolutions per minute, the peripheral speed of the cutters would be about 4,600 feet per minute. In accordance with the conditions described

above, it would be preferred to rotate the disk plates at least 920 feet per minute and preferably much higher speeds.

Referring to Figure 4, AT represents the basic length of the element and CD its thickness. Since $AD \times DT$ equals $CD \times DE$ or approximately $CD \times CE$, when CD is 0.025 inch and CE is 10 inches, $CD \times CE$ equals $\frac{1}{4}$ square inch and AD therefore equals $\frac{1}{2}$ inch. Thus, under these conditions, the basic length of the element AT will be 1 inch. When it is desired to increase the length, as to $1\frac{1}{2}$ inches, then while the cutting knife is engaged in the wood from T to A, it will be necessary to move the spool carrying the head through a distance GT plus AH, that is, through the extra $\frac{1}{2}$ inch desired.

Under these illustrative conditions, the peripheral speed of the disk plates would be adjusted to one-half that of the cutter heads or 2300 feet per minute since the center of the cutter head J will have to move $\frac{1}{2}$ inch while it rotates from T to A, which is approximately 1 inch, the basic length of a 0.025 inch element made with a 10 inch diameter head. It will be apparent that if the cutter head moved very slowly forward in comparison to its peripheral speed, the shape of the element cut would be somewhat triangular as represented by the letters CAH in Figure 4 and the length slightly greater than AC, or $\frac{1}{2}$ inch, for the condition cited. It is preferred that the knives be spaced apart to correspond to the maximum length desired for the element.

It will be apparent from the description that there is provided an improved mechanism for severing wafers from blocks of wood such as wood waste and the like to produce elements which may be varied as desired in thickness, in length, in the tapers of the edges and in the direction of cut in accordance with the uses to be made thereof, whether in the manufacture of boards molded under heat and pressure or acoustical tile of lower density or the like. The apparatus described embodies means for positively feeding and maintaining the pieces of wood to be waferized in position for engagement with the cutting elements so as to produce a more uniform and more desirable wafer for use in the manufacture of structures having better control as to strength, appearance and uniformity of fibers contained therein.

As previously described, the thickness of the wafers cut will depend chiefly on the rate of feed of the wooden blocks into the area for engagement with the cutting blades. The length of the fibers, as previously described, also depends upon relative movement between the cutting blades in the cutter head and the speed of rotation thereof. The other dimension remains positive and is independent of the rate of feed or speeds of rotation since it depends on the spaced relation between the scoring elements across the space between the disk plates or the width of the scallops or staggered knives forming the cutting elements.

As used herein and in the claims, the phrase "cut substantially parallel to the grain of the wood" is meant to include cutting by knives having their edges held across and moved parallel to the grain of the wood or else held parallel to and moved across the grain of the wood.

It will be understood that other means may be employed for advancing the wooden elements in feeding relation with the cutter heads and that other changes may be made in the details of construction, arrangement and operation, particularly with respect to the mounting and to the arrangement of the cutter heads and scoring elements in the periphery of a rotating cylinder for operative engagement with pieces of wood to be separated into wafers of predetermined dimension and curvature, without departing from the spirit of the invention, especially as defined in the following claims.

What is claimed is:

1. Apparatus for reducing blocks of wood into fibrous elements tapered at both ends and cut substantially parallel to the grain of the wood comprising a supporting

frame mounted for rotational movement about an axis, a plurality of spaced cutting cylinders mounted for independent rotational movement in said frame about a parallel axis and positioned in equally spaced relation from the frame axis, a plurality of cutting blades extending crosswise from the periphery of the cylinder, driving means for rotating the frame and for rotating the cutting cylinders independently of the frame but in the same direction thereof, means for feeding blocks of wood with the grain of the wood parallel to the axis in the direction toward the frame into engagement with the cutting blades for severing fibrous elements from the blocks, and scoring members positioned on the frame intermediate the cutting cylinders and spaced from the axis of the frame to extend slightly beyond the blades on the cutting cylinders.

2. Apparatus as claimed in claim 1 in which the scoring members are spaced one from another crosswise on the frame and in which the laterally spaced relation corresponds to the width of the fibrous elements to be cut.

3. Apparatus as claimed in claim 1 in which the scoring elements are inclined at an angle of between 20-50° from the radial.

4. Apparatus for reducing the side face of a block of wood along its entire length into fibrous elements cut parallel to the grain of the wood comprising a framework mounted for rotational movement about its axis, a plurality of elongate cutting cylinders mounted in circumferentially spaced apart relation in outer portions of the framework to extend across the length thereof and for rotational movement independent of the framework about separate axes parallel to the axis of the framework, cutting blades extending outwardly from the periphery of the cutting cylinders parallel to their axes for a length corresponding at least to the length of the block of wood, means for actuating the framework for rotational movement about its axis to carry the cutting cylinders therewith, means for actuating the cutting cylinders for rotational movement at high speed about their respective axes independent of the rotational movement of the framework, and feeding means for advancing the block of wood towards the periphery of the rotating cylinders with its face substantially parallel to the axis of rotation of the cutting cylinders and the framework.

5. Apparatus for reducing the side face of a block of wood along its entire length into fibrous elements cut parallel to the grain of the wood comprising a cylindrical frame mounted for rotational movement about its axis and dimensioned to have a length greater than the length of the block of wood, a plurality of elongate cutting cylinders mounted in circumferentially spaced apart relation in the peripheral portion of the frame for rotational movement independent of the frame about axes parallel to the axis of the frame, cutting blades extending outwardly peripherally from the cutting cylinders parallel to their axes and having a length corresponding at least to the length of the block of wood, means for actuating the cylindrical frame for rotational movement about its axis, means for actuating the cylinders for independent rotational movement about their respective axes, and feeding means for advancing the block of wood towards the periphery of the rotating cylinders with its face substantially parallel to the axis of rotation of the cutting cylinders and the framework.

6. Apparatus for reducing the side face of a block of wood along its entire length into fibrous elements cut parallel to the grain of the wood comprising a framework mounted for rotational movement about its axis, a plurality of elongate cutting cylinders mounted in circumferentially spaced apart relation in the outer periphery

of the framework and for rotational movement independent of the framework about separate axes parallel to the axis of the framework, cutting blades extending outwardly radially from the periphery of the cutting cylinders and from the framework dimensioned to have a length corresponding at least to the length of the block of wood, means for actuating the framework for rotational movement about its axis, means for actuating the cutting cylinders for rotational movement at high speed about their respective axes independent of the rotational movement of the framework, and feeding means for advancing the block of wood towards the periphery of the rotating cylinders with its face substantially parallel to the axis of rotation of the cutting cylinders and the framework.

7. Apparatus for reducing the side face of a block of wood along its entire length into fibrous elements cut parallel to the grain of the wood, comprising a plurality of rapidly rotating cutting cylinders, each bearing staggered cutting edges on its periphery and parallel to its axis, said edges being as long as the width of the fibrous elements and spaced along the cylinder for at least the length of the block of wood, a framework rotating rapidly in the same direction as said cylinders and bearing a plurality of said cylinders on its periphery, and feeding means for advancing said block towards the rotating cylinders with its face substantially parallel to the axes of rotation of the cutting cylinders and the framework.

8. Apparatus for reducing the side face of a block of wood along its entire length into fibrous elements cut parallel to the grain of the wood, comprising a framework mounted for rotational movement about its axis, a plurality of elongate cutting cylinders mounted in circumferentially spaced apart relation in the outer periphery of the framework and for rotational movement independent of the framework about separate axes parallel to the axis of the framework, cutting elements extending outwardly from the periphery of the cylinders and from the periphery of the framework and having staggered cutting edges, each of which is dimensioned to have a length corresponding to the width of the fibrous elements and spaced along the cutting cylinder for at least the length of the block of wood, means for actuating the framework for rotational movement about its axis, means for actuating the cutting cylinders for rotational movement at high speed about their respective axes independent of the rotational movement of the framework, and feeding means for advancing the block of wood towards the periphery of the rotating cylinders with its face substantially parallel to the axis of rotation of the cutting cylinders and the framework.

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