

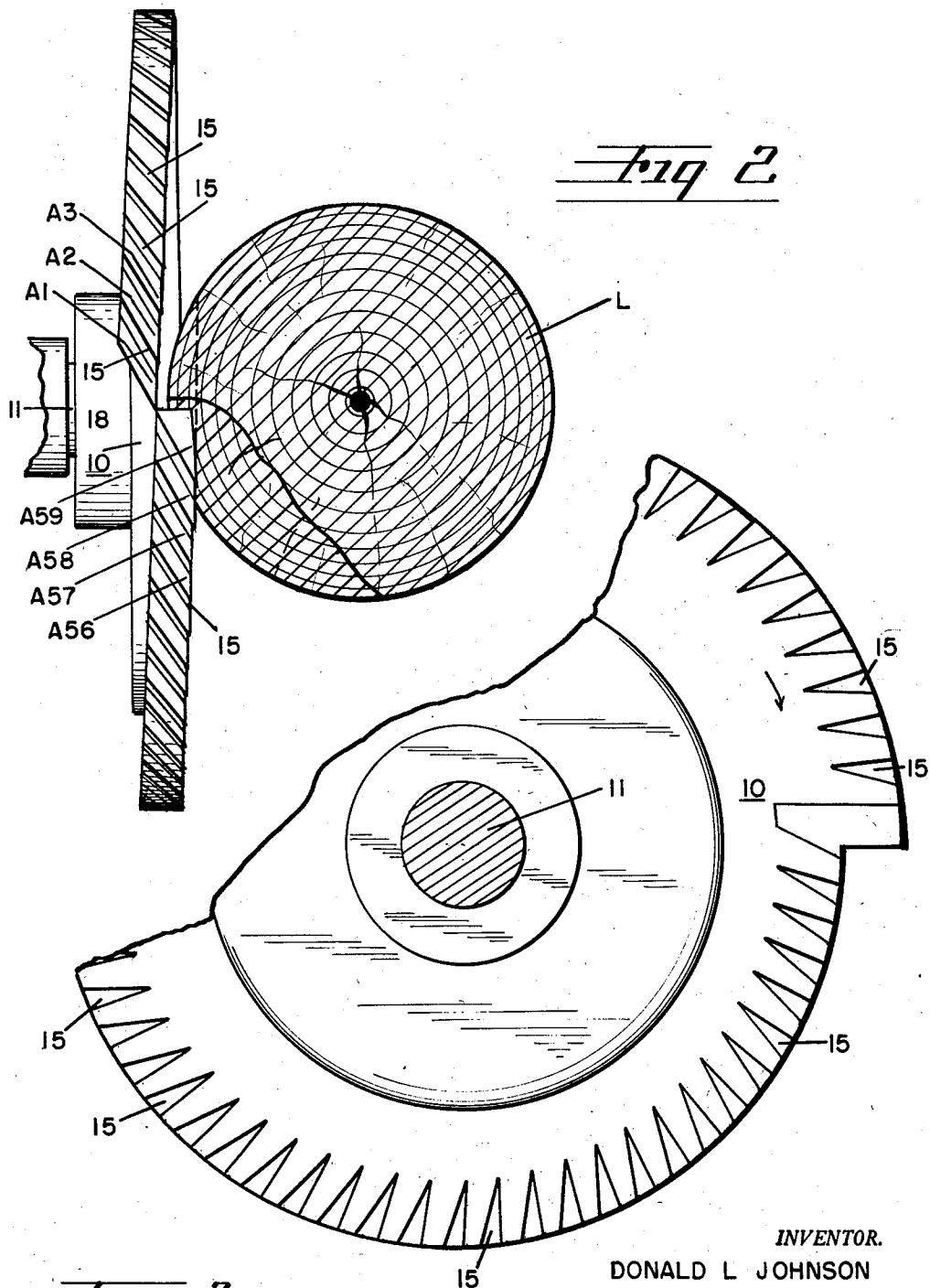
June 9, 1959

D. L. JOHNSON
METHOD AND MEANS FOR CUTTING A FLAT SURFACE
ON WOOD BY PRODUCING WOOD FLAKES
FROM THE MATERIAL AS REMOVED

2,889,859

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3 Sheets-Sheet 2



INVENTOR.
DONALD L JOHNSON
BY *F. L. Geisler*
ATTORNEY

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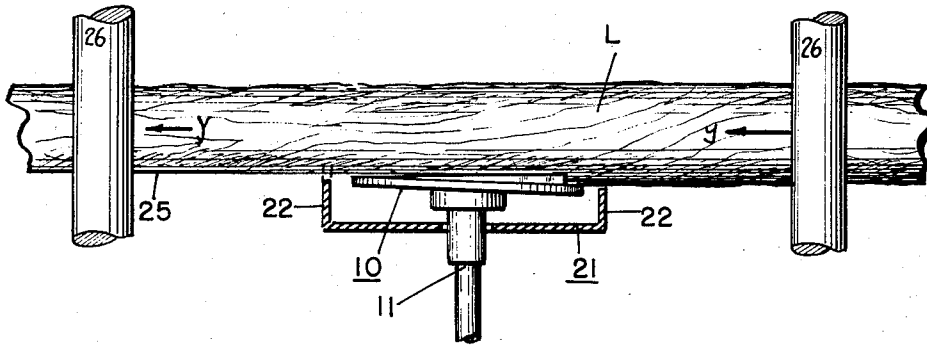


Fig 5

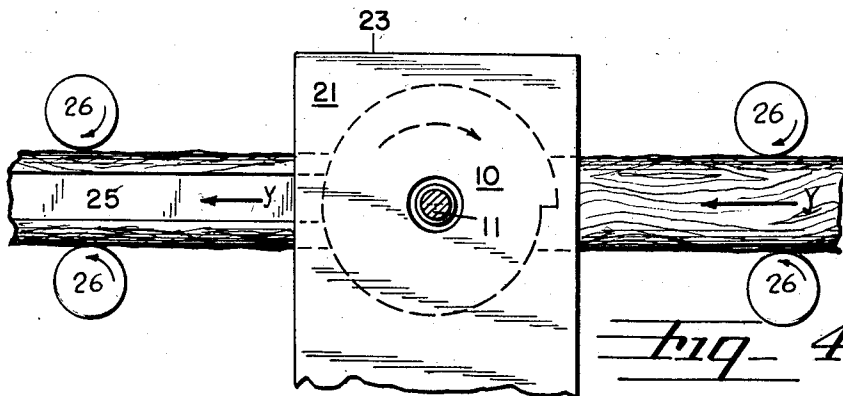


Fig 4

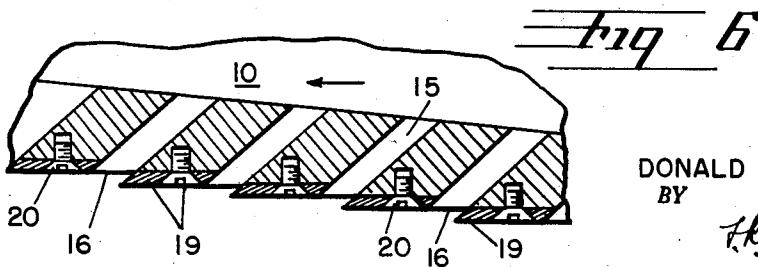


Fig 6

INVENTOR.
DONALD L JOHNSON
BY

H. J. Giesler
ATTORNEY

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METHOD AND MEANS FOR CUTTING A FLAT SURFACE ON WOOD BY PRODUCING WOOD FLAKES FROM THE MATERIAL AS REMOVED

Donald L. Johnson, Tacoma, Wash.

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10 Claims. (Cl. 144—176)

This invention relates especially to the cutting of a flat surface on wood, and, in particular, to the cutting of such surfaces on logs and timbers and the production of thin wood flakes as the result of such cutting operation.

Briefly, this invention involves the cutting of a surface along the wood by making a succession of cuts at a gradually increased depth across one side, with the size of the individual cuts corresponding to the desired size for the wood flakes, and continuing the succession of cuts while moving the wood in a direction substantially normal to the direction in which said cutting takes place, the movement of the wood being at such a rate of speed that the repeated succession of cuts will be extended evenly over the entire length of the side being cut.

In the employment of the invention for the cutting of wood surfaces, the invention is thus concerned not only with lumber manufacturing but also with the producing of improved wood flakes, which, in turn, are particularly desirable for use in the manufacture of such products as flake boards and also for the production of wood pulp and for use in the paper industry.

Consequently, the main objects of the invention are two-fold: to provide a more effective and efficient method and means by which flat smooth surfaces can be cut on logs, poles, waned edges of cants and the like, and also to provide a practical method and means by which an improved wood flake, highly desirable for the purposes above mentioned, will be produced by such wood cutting.

In the ordinary manufacture of timbers and other lumber from logs, since the logs are more or less round and for the most part substantially straight, the practice is to saw the log longitudinally along one side first, preparatory to the cutting of timbers and smaller boards in the usual manner. The sawing of the logs results in sawdust waste and also in slabs, edgings and tapers. Tapers are produced from what is commonly called taper sawing, which is the practice of cutting parallel with the log grain in the outer portion of the log, leaving tapers to be removed from the inner and less valuable portion. In earlier sawmill operations, these slabs, edgings and tapers were considered unsuitable for any use or of such insignificant value that they were merely dumped into a burner to be consumed by fire. Then, in many mills, the practice was followed of breaking up these slabs and waste pieces and utilizing them as cheap fuel, while later in some mills where conditions are favorable it has become the practice to convey these slabs and edgings from logs to chipping machines to be converted into chips for making wood pulp, paper, fiber board and like products. Where these slabs, edgings and tapers are thus utilized to produce chips for wood pulp, it is generally customary to debark the logs first before any sawing takes place,

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and both mechanical and hydraulic debarkers are now widely employed.

While this utilization of slabs, edgings and tapers for the production of wood chips is a considerable advance over the former practice of treating such material as mere waste or cheap fuel, there are still difficulties and problems involved in the handling of this material before it is ultimately converted into chips.

In the mills considerable equipment in the form of transfers, slasher saws, heavy conveyors, and chippers is required to convert these slabs, edgings and tapers into wood chips. Additional labor is required for handling the flared slabs and odd-shaped pieces and for the sorting of the lumber from the waste material.

An important object of the present invention is to enable desired flat surfaces to be cut on logs while simultaneously converting the removed surface portions directly into usable wood flakes, instead of producing the removed portions first in the form of slabs and edgings which necessitate further handling before their subsequent conversion into such usable flakes.

A related object of the invention is to provide an improved method and means whereby a straight smooth surface can be cut along a log without the customary sawing, and thus without having excessive waste material in the form of sawdust.

An additional object is to produce a flat cut surface along a log which will be smoother than that produced merely by the customary saw cut.

During recent years an important use for wood particles, including shavings and similar wood waste from the woodworking industry, has developed in the making of so called particle boards. The material is mixed with resin and the latter is polymerized under heat and pressure in the forming of the board. While such manufactured boards have several good features, they heretofore have often lacked desired strength and thus showed a low modulus of elasticity and resistance to rupture. This weakness has been found to be attributable to the fact that the wood particles used for such boards are without any uniformity as to size and shape and that in the wood particles the grain, instead of extending longitudinally, extends crosswise and thus greatly reduces the inherent strength of such individual particles.

Recent experiments in the manufacture of composite boards have shown that if specially cut wood flakes, being cut so as to have a thin cross-section and being cut substantially parallel to the grain of the wood, instead of across the grain, are substituted in place of heterogeneous wood particles and in place of heterogeneously cut and cross-grain-cut wood flakes, a considerably improved and much stronger board results, and the use of such improved wood flakes is now being adopted on a small scale in the manufacture of the modern flake board. The reason that such improved type of flake board has not as yet been produced in greater quantity and offered more extensively on the market, although such a product is believed to be capable ultimately of competing favorably with plywood for most purposes, is due to the fact that heretofore an entirely satisfactory and practical way of producing such uniform wood flakes of this type and for this and other purposes had not been found.

While some machines have been made for producing wood flakes of this special desirable type, to the best of my knowledge such machines are capable of using only wood blocks which have been first specially cut into short

pre-determined lengths and then fed into the flaking or shaving machine. Such procedure makes the production of the wood flakes too costly to be practical. Furthermore, when the blocks are made from waste material which has become dried, the blocks must be moistened in order to enable proper wood flaking to take place. This further increases the cost of production.

Accordingly, another particular object of the present invention is to enable improved and uniform wood flakes of the desired type above mentioned to be made in a more practical way and at a lower cost and from otherwise more or less waste material.

An additional and specific object of the invention is to provide improved method and means whereby such desirable wood flakes can be cut from a log surface during the initial operation of cutting the flat surface along one side of the log while the log is in a green and favorable condition for flaking.

In the production of wood pulp and paper improved processes have recently developed in which the raw material is restricted to wood in the form of very thin flakes as distinguished from the ordinary wood chips commonly used for this purpose. So far, these improved processes have not come into general use due also to the difficulty of reducing wood to the required thin flakes. Another object of this invention, therefore, is to provide a method and means whereby the thin wood flakes, suitable for these improved pulping processes, can be produced in such a practical and satisfactory manner, and in comparison with the present wood chips for pulp, that extensive adoption of these improved processes of pulp production will become feasible.

The manner in which the various objects above indicated are attained with the present invention, the novel method which the invention embodies, and a satisfactory means for carrying out the method, will be briefly explained and described with particular reference to the accompanying drawings.

In the drawings:

Figure 1 is an elevation showing the working face of the special cutter head designed as a means for the carrying out of the invention;

Figure 2 is a side elevation of the cutter head taken on line 2—2 of Figure 1, illustrating the cutter head in operation on a log, cross sectional portions being shown of a moving log being engaged by the cutter head;

Figure 3 is an elevation of a portion of the rear face of the cutter head taken opposite from Figure 1;

Figure 4 is an elevation, taken from the rear side of the cutter head, drawn to a smaller scale and more or less diagrammatic, showing the hood over the cutter head, illustrating the cutter head in the operation of cutting the flat surface on a log and of producing the desired wood flakes as a result of such cutting, the helical-spiral course of the cutters on the working face of the cutter head being indicated in broken lines;

Figure 5 is a corresponding plan view illustrating the operation; and

Figure 6 is a fragmentary enlarged side elevation of the cutter head but showing removable knives mounted on the same.

The cutter head, indicated in general by reference character 10, is secured on the end of a driven shaft 11, which shaft is supported and rapidly driven by suitable means (not shown), the direction of rotation of the shaft and cutter head in the device as illustrated being indicated by the arrows in Figures 1, 3, 4 and 6, and thus being counter-clockwise in Figure 1. The wood-engaging face of the cutter head, as shown in Figure 1, is formed with a helical-spiral course 12 which extends in a direction opposite the direction of rotation of the cutter head and gradually and constantly approaches the axis of rotation in the nature of a spiral, while at the same time progressing forwardly into the work, that is to say, in a forward direction longitudinally with respect to the rota-

tional axis, in the nature of a helix. This helical-spiral course 12 has a peripheral working or cutting portion 13 which is of constant width throughout its extent. Thus each peripheral arc of this working portion is both an arc of a spiral and an arc of a helix, or may also be described as an arc of a conical spiral, as distinguished from an arc of a plane spiral. The working portion might further be described as radially retreating while axially advancing towards the work. The width of this working portion corresponds to the desired size or length (measured longitudinally with the grain) of the special wood flakes to be produced by the cutting of the wood. For example, if wood flakes of 2 inch size are desired, which is a desirable size of flakes both for flake boards and for wood pulp and use in the paper industry, the working portion 13 of the helical-spiral course 12 would be exactly 2 inches wide.

The peripheral working portion 13 of the helical-spiral course 12 is provided with a series of identical cutting tools or knives which extend entirely across the working portion. In the cutter head as illustrated there are 59 of these knives, as indicated by the references A1, A2 . . . A59. Ahead of each of these cutting tools or knives is a discharge passageway or slot 15 which extends into the cutter head from the periphery of the working portion to enable the flakes made by the tools or knives to be cleared from the work and from the working face of the cutter head as they are produced. Thus the cutting edge of each tool or knife is positioned in the rear edge of its corresponding discharge passageway or slot in the direction of rotation of the cutter head.

In the preferred cutter head construction, as illustrated in the drawings, the helical-spiral course 12 is composed of a series of similar stepped plane surfaces 16, each perpendicular to the rotational axis of the cutter head, the difference in the elevation or level between each adjacent surface plane 16 corresponding to and determining the desired thickness of the wood flakes to be cut. For example, if wood flakes of 0.025 of an inch in thickness are desired, each of the surfaces 16, which form the helical-spiral course 12, and in the outer ends of which the cutting tools or knives are provided, considered in the direction opposite the direction of rotation of the cutter head, would be ground to 0.025 of an inch below the preceding surface 16.

The walls of the discharge passageways or slots 15 extend in planes which are oblique to the axis of rotation of the cutter head and slope from the working face of the cutter head in a direction away from the direction of rotation, as shown in Figure 2. These receive the flakes as cut, whereupon the flakes are discharged from the periphery of the cutter head.

Preferably, the rear walls of the discharge passageways or slots 15 extend along radial lines in the cutter head and similarly the forward or cutting edges of the tools or knives are positioned radially around the peripheral portion 13 of the cutter head, coinciding with the rear walls of their related slots respectively. Also preferably the cutting edges of the tools or knives are spaced the same arcuate distance apart throughout the peripheral cutting portion 13 of the helical-spiral course 12. The cutting edges of the tools or knives are all the same length.

These cutting tools or knives may be formed either as a permanent part of the cutter head, consisting of specially hardened metal applied to the body metal of the cutter head, or may be made as separate and removable knives. Such optional construction of the knives is illustrated in Figure 6 wherein the knives 19 are shown set in recesses provided in the working face of the cutter head and are secured in place by countersunk screws 20. In either case the outer faces or surfaces of the tools or knives will be flush with the remaining portion of the corresponding surface areas of the surfaces 16 which form the helical-spiral course 12.

A stationary hood 21 (Figures 4 and 5) extends over the cutter head for the purpose of receiving the flakes

as discharged from the cutter head periphery. This hood is supported in any suitable manner (not shown) over the cutter head and extends over the portion of the wood which is being cut. While this hood may be formed in various ways, the simple type of hood illustrated in Figures 4 and 5 is considered satisfactory and preferable. The hood has a pair of parallel side walls 22 which are arranged in planes substantially perpendicular to the axis of the log or perpendicular to the direction of travel of the wood which is being cut. One end of the hood such as the end 23, is open to act as an air intake while the other end will be connected by a duct with a suitable blower (not shown) for the purpose of carrying away the flakes. Due to the speed at which the cutter head will be rotated, the flakes will be discharged from the discharge passageways between the knives almost immediately upon being received into the discharge passageways and freed from the body of the wood.

The operation of the cutter head and the manner in which the desired objects are achieved specifically in the cutting of a log will now be briefly explained with references to Figures 1, 4 and 5. The size of the cutter head required will depend upon the size of the logs to be cut or the width of the surface to be cut in the wood, but it will be understood from Figures 1 and 4 that the cutter head and, more specifically, the peripheral cutting portion 13 of the helical-spiral course 12 on the working face of the cutter head, must extend beyond the edge of the surface to be cut. In other words, the minimum radius of curvature of the outer periphery at the termination of the cutting portion 13 of the helical-spiral course must be at least greater than half the width of the surface to be cut. In Figures 4 and 5 the log is indicated by L and the flat surface which is cut along one side of the log is indicated at 25, this flat surface being cut as the log is moved longitudinally past the rotating cutter head, by any suitable manner such as driven feed rolls indicated diagrammatically at 26 in Figs. 4 and 5, in a direction perpendicular to the axis of the cutter head, as indicated by the arrow Y.

Assuming that the axis of the cutter head remains fixed while the log moves longitudinally or lengthwise during the cutting (although it would also be possible, though less practical, to have the axis of the rotating cutter head moved with respect to a stationary log), the relative movement of the log must correspond to the rate at which the cutting takes place. If, for example, the width of the peripheral portion 13 of the helical-spiral course on the cutter head is 2 inches, the longitudinal or lengthwise movement of the log should be 2 inches for each rotation of the cutter head. Thus, with the cutter head rotating at 1,800 r.p.m., the travel of the log should be exactly 300 feet per minute. Each cutting tool or knife would then in turn pass over the same portion of the log face, with the result that a flat cut surface would be left on the log. Obviously, the feed rate of the log must be carefully synchronized with the rotational speed of the cutter head. The cutting tools or knives could of course be made in any length desired depending on the desired length for the wood flakes, and thus might be any length from $\frac{1}{2}$ inch to 5 inches more or less. A length of approximately 2 inches however is considered a preferred length in most instances. The thickness of the flakes, as previously mentioned, will be determined by the difference in level between the consecutive cutting tools or knives, the thickness of 0.025 of an inch being previously mentioned as a desirable wood flake thickness. With such an arrangement of the cutting tools or knives a total of 60 tools or knives in the peripheral cutting portion 13 of the helical-spiral course 12 of the cutter head, for example, would result in the cutting of a flat surface on the log or wood at a maximum depth of 1.5 inches.

A very important achievement in the cutting of the

log or wood surface is the fact that the wood flakes produced are cut substantially across the grain of the wood, with flexure mainly parallel with the grain. This action results in uniform flakes of uniform strength, undamaged in strength properties, greatly reduces the damage to the fibers through crushing and bruising, eliminates a large percentage of the small fines, and produces a higher grade of wood pulp or other product, while the uniform size and thinness of the flakes enables more uniform and more speedy digestion of the wood in the pulping process or a more uniform and stronger product if converted into panel board or like product.

Actually, in the preferred cutter head which I have illustrated and described the knives or tools are rotating in planes parallel with the surface to be cut simultaneously with the longitudinal travel of the log, resulting in a desirable slicing action with the flexing of the flakes mainly parallel with the fibers of the flake. Since there are numerous knives cutting flakes from the same place on the log, the knives are performing slicing parallel with the fibers or grain of the log with the shearing of one end of each flake from the end of the material to be removed.

While other devices could be used for cutting a series of slices transversely across the wood surface, and thus for performing substantially the same method and producing the desired wood flakes, I consider the rotating cutter head, substantially as described, to be the preferred means for carrying out of the method of invention.

I claim:

1. The method of producing a continuous flat surface on wood which consists in making a succession of slicing cuts across the grain of the wood in parallel planes at uniformly increasing depth respectively and continuing such succession of cuts while moving the wood relatively in a direction substantially parallel to said cutting planes, so as to cause the cutting to be extended evenly over the entire cut side of the wood.

2. The combined method of cutting a continuous flat surface on wood and of producing wood flakes, which consists in making a succession of identical cuts of desired flake size across the grain of the wood, said cuts being made in parallel planes respectively, at gradually increasing depth across one face of the wood, and continuing said succession of cuts while moving the wood relatively in a direction substantially parallel to said cutting planes and at a speed synchronized with the speed of the cutting.

3. The method of producing thin wood flakes from a log or other wood mass of substantial length, which consists in making a succession of slices across the grain on one face of the wood at gradually increasing depth, and continuing said succession of slices while moving the wood relatively in a direction substantially parallel to the cut slices and parallel to the wood grain at such speed as to cause the succession of slices to be performed evenly over the entire length of said face.

4. In a wood cutting device of a character described, a rotating cutter head having a work-engaging face arranged for engagement with one side of the mass of wood to be cut, said face having a helical-spiral working portion extending in a direction opposite the direction of rotation of said cutter head, said working portion progressing forwardly about the axis of rotation of said cutter head and constantly approaching said axis, a series of cutters mounted on said work-engaging face along said working portion, the forward edges of said cutters extending across said working portion, and said working portion having discharge passageways located immediately ahead of said forward edges of said cutters respectively.

5. In a device for cutting a flat surface on an elongated mass of wood, a rotating cutter head having a work-engaging face arranged for engagement with one side of the mass of wood to be cut, said face formed with a

helical-spiral working portion beginning near the outer periphery of said face and extending in a direction opposite the direction of rotation of said cutter head, said working portion progressing forwardly about the axis of rotation of said cutter head and constantly approaching said axis, said working portion being of constant width throughout its extent, the minimum radius of curvature of the outer periphery of said working portion at its termination being greater than half the width of the desired surface to be cut on said mass of wood, a series of cutters mounted on said work-engaging face along said working portion and spaced substantially the same arcuate distance apart, the cutting edges of said cutters extending across said working portion, said cutters being of identical length, and said cutter head having a plurality of discharge passageways extending across said working portion and located immediately ahead of said cutting edges of said cutters respectively, the walls of said discharge passageways sloping oppositely from the direction of rotation of said cutter head, whereby, upon the contact of said mass of wood with said working face of said rotating cutter head and relative movement of said mass of wood with respect to said axis of rotation of said cutter head in a plane perpendicular to said axis and at a rate of speed properly synchronized with the speed of rotation of said cutter head, said cutters will remove flakes from said mass of wood while cutting a flat surface on said mass of wood.

6. In a wood flaking device for use on an elongated mass of wood, a rotating cutter head having a work-engaging face arranged for engagement with one side of the mass of wood to be cut, said face provided with a helical-spiral peripheral working portion extending in a direction opposite the direction of rotation of said cutter head, said peripheral working portion progressing forwardly about the axis of rotation of said cutter head and constantly approaching said axis, a series of cutters on said working portion, the forward cutting edges of said cutters extending inwardly from the periphery of said working portion, and said cutter head having discharge passageways extending inwardly from the periphery of said helical-spiral working portion and located immediately ahead of said cutting edges of said cutters respectively.

7. In a device of the character described for cutting a flat surface on an elongated mass of wood, a rotating cutter head having a work-engaging face arranged for engagement with one side of the mass of wood to be cut, said face formed with a helical-spiral course having a peripheral working portion extending in a direction opposite the direction of rotation of said cutter head, said course and said working portion progressing forwardly about the axis of rotation of said cutter head and constantly approaching said axis, said working portion being of constant width throughout its extent, the minimum radius of curvature of the outer-periphery of said working portion at its termination being greater than half the width of the desired surface to be cut on said mass of wood, a series of knives mounted on said work-engaging face along said working portion of said course and spaced substantially the same arcuate distance apart, the cutting edges of said knives extending across said working portion of said course, said knives being of identical length, and said cutter head formed with a plurality of similar discharge passageways extending across said working portion of said helical-spiral course and located immediately ahead of said cutting edges of said knives respectively, whereby, upon the contact of said mass of wood with said engaging face of said rotating cutter head and longitudinal movement of said mass of wood in a plane perpendicular to said axis of said cutter head and at a rate of speed properly synchronized with the speed of rotation of said cutter head, said knives will remove flakes from said mass of wood while cutting a flat surface on said mass of wood.

8. In a wood cutting and flaking device for use on an elongated mass of wood, a rotating cutter head having a work-engaging face arranged for engagement with one side of the mass of wood to be cut, said face formed with a helical-spiral course having a peripheral working portion extending in a direction opposite the direction of rotation of said cutter head, said course and said working portion progressing forwardly about the axis of rotation of said cutter head and constantly approaching said axis, said working portion being of constant width throughout its extent, said helical-spiral course formed with a series of identically stepped surfaces each perpendicular to said axis of rotation, the minimum radius of curvature of the outer periphery of said working portion at its termination being greater than half the width of the desired surface to be cut on said mass of wood, a series of knives mounted on said work-engaging face along said working portion of said course, the cutting edges of said knives extending across said working portion of said course in lines radial with respect to said axis, and said cutter head having discharge passageways in said working portion of said helical-spiral course located immediately ahead of said cutting edges of said knives respectively, the rear walls of said discharge passageways extending in planes oblique to said axis of rotation, whereby, upon the contact of said mass of wood with said work-engaging face of said rotating cutter head and longitudinal movement of said mass of wood in a plane perpendicular to said axis of said cutter head and at a rate of speed properly synchronized with the speed of rotation of said cutter head, said knives will remove flakes by cross-grain cutting from said mass of wood while cutting a flat surface on said mass of wood.

9. In a wood cutting and flaking device for use on a log, a rotating cutter head having a work-engaging face arranged for engagement with one side of the log to be cut, said face formed with a helical-spiral course having a peripheral working portion extending in a direction opposite the direction of rotation of said cutter head, said course and said working portion progressing forwardly about the axis of rotation of said cutter head and constantly approaching said axis, said working portion being of constant width throughout its extent, said helical-spiral course formed with a series of identically stepped surfaces of the same arcuate width, the minimum radius of curvature of the outer periphery of said working portion at its termination being greater than half the width of the desired surface to be cut on said log, a series of knives mounted on said work-engaging face along said working portion of said course and spaced substantially the same arcuate distance apart, the cutting edges of said knives extending across said working portion of said course, said knives being of identical length, said working portion having discharge passageways extending across said working portion of said helical-spiral course and located immediately ahead of said cutting edges of said knives respectively, the rear walls of said discharge passageways sloping obliquely inwardly away from said work-engaging face, whereby, upon the contact of said log with said work-engaging face of said cutter head and longitudinal movement of said log in a plane perpendicular to said axis of said cutter head and at a rate of speed properly synchronized with the speed of rotation of said cutter head, said knives will remove flakes by cross-grain cutting from said log while cutting a flat surface on said log, and a hood extending over said cutter head for directing the discharge of the wood flakes thrown off by said cutter head.

10. In a cutting assembly for a woody substance, a rotating member having a series of substantially radial slicing knives arranged in a radially retreating, axially advancing knife line, the cutting edge of the final knife in said knife line extending slightly beyond the work-engaging face of said member, said knife line having discharge passageways between said knives to provide axial

discharge of the slices cut from the woody substance, means for rotating said member and means for moving said woody substance past said face of said member in a direction perpendicular to the axis of rotation of said member at a speed not greater than the radial retreat of said knife line, whereby a continuous surface will be cut on said woody substance at a depth not exceeding the axial advance of said knives with the width of said cut surface not greater than twice the radius of the outer peripheral end of said final knife in said knife line.

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