Dec. 13, 1960 D. L. JOHNSON 2,964,079

WOOD FLAKING AND SURFACING MACHINE

Filed Dec. 9, 1957 3 Sheets-Sheet 1

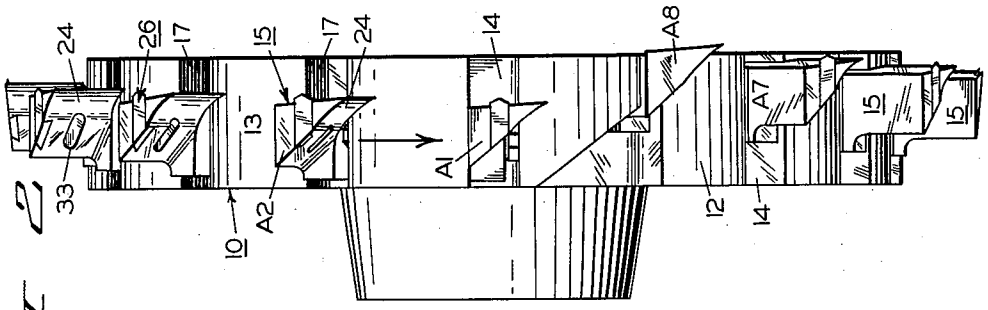


Fig. 2

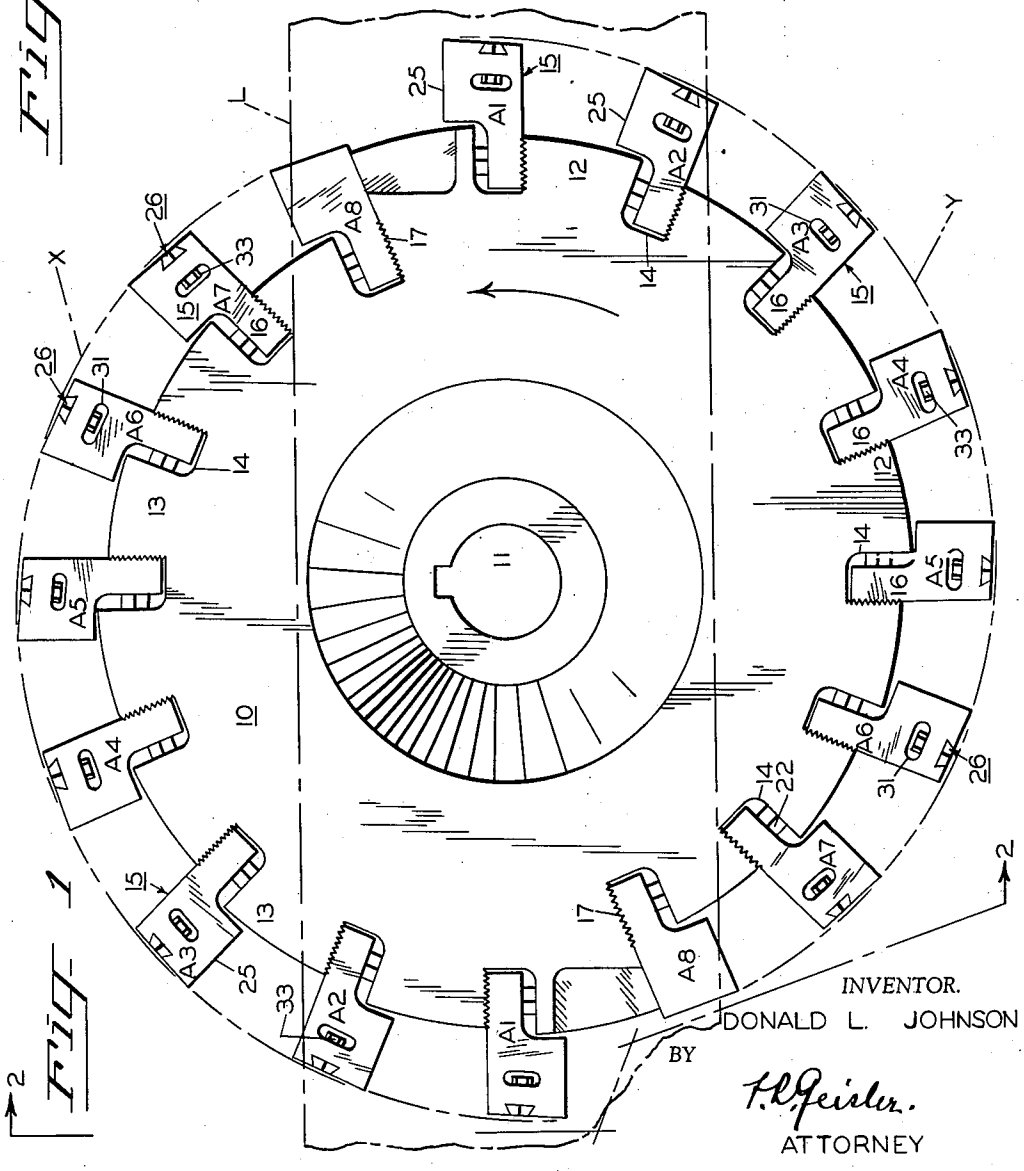


Fig. 1

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WOOD FLAKING AND SURFACING MACHINE

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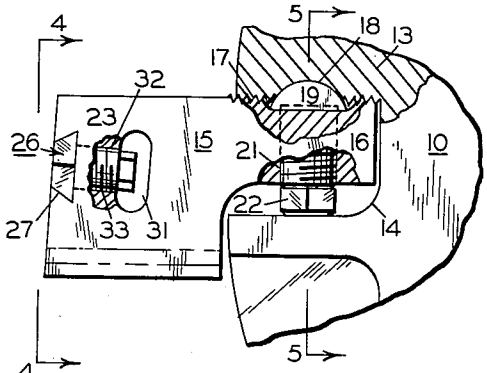


Fig. 3

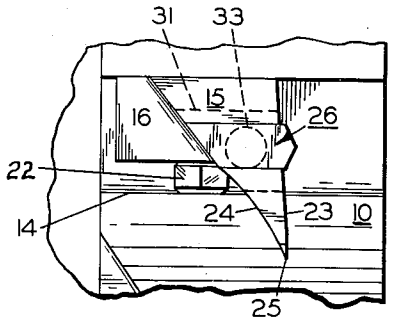


Fig. 4

Fig. 5

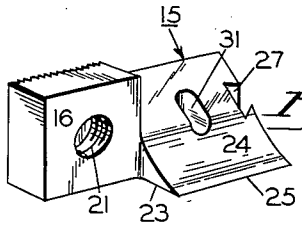
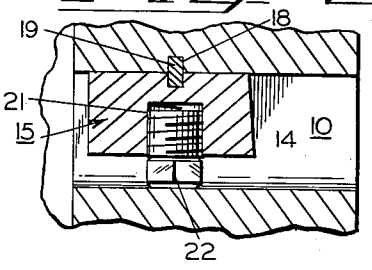


Fig. 6



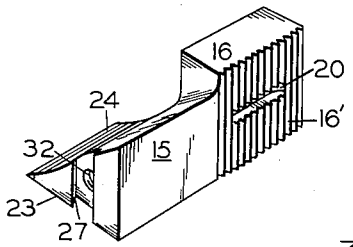


Fig. 7

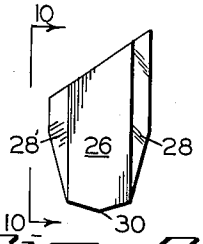


Fig. 8

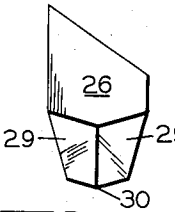


Fig. 9

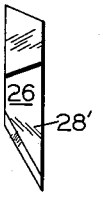


Fig. 10

Fig. 12

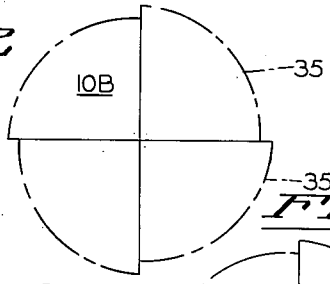


Fig. 14

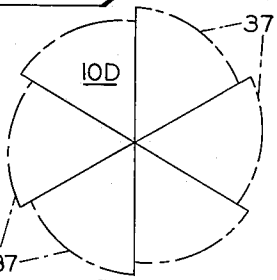


Fig. 11

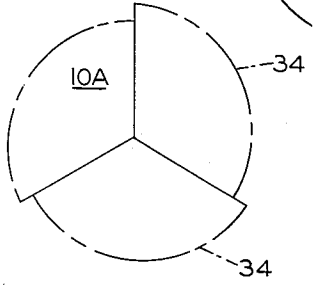
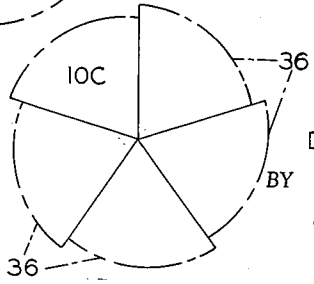


Fig. 13



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WOOD FLAKING AND SURFACING MACHINE

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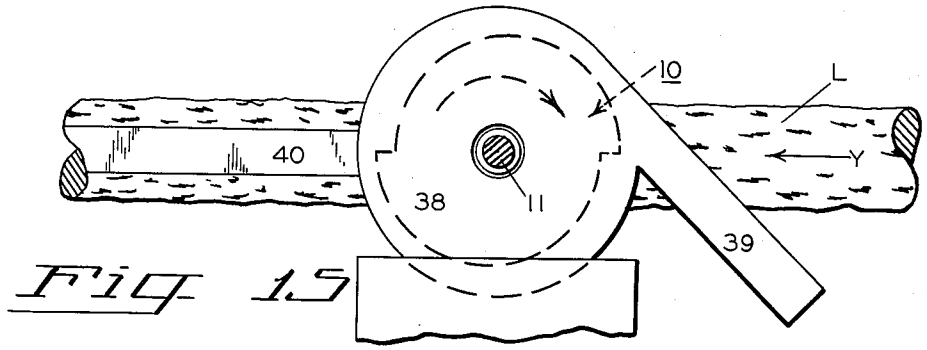


Fig. 15

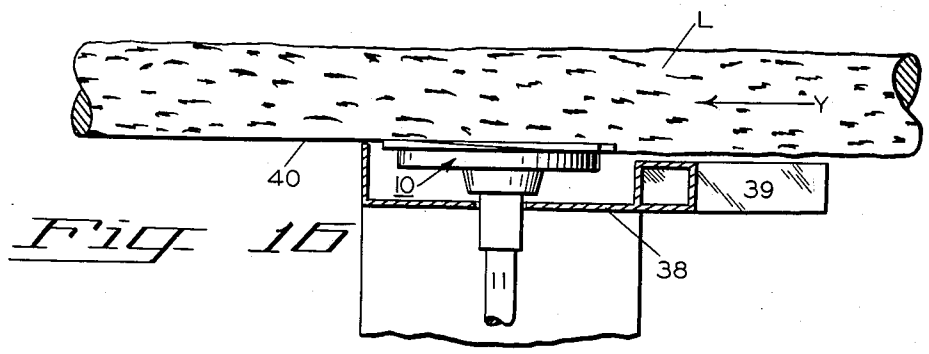


Fig. 16

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WOOD FLAKING AND SURFACING MACHINE

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Filed Dec. 9, 1957, Ser. No. 701,405

8 Claims. (Cl. 144—176)

The present invention relates to the cutting of a flat surface along logs, cants, timbers, rough lumber and the like, while producing desired wood flakes of a predetermined quality, size and shape, such cutting and flaking being accomplished by means of a rotating cutter head having cutting knives arranged in a helical-spiral formation, while relative movement of the wood with respect to the cutter head takes place in a direction perpendicular to the axis of the rotating cutter head. The invention described in this application is related to that described in my pending application Serial No. 627,687, filed under date of December 11, 1956, and entitled "Method and Means for Cutting a Flat Surface on Wood by Producing Wood Flakes From the Material as Removed," now U.S. Patent No. 2,889,859.

The said previous application, Serial No. 627,687, describes a particular device through the medium of which such wood flaking and surfacing may be accomplished. The object of the present invention is to provide a further improved means for carrying out the method described in this previous application and thus a further means for producing special and novel wood flakes while simultaneously cutting a desired flat surface longitudinally along a log, timber, or other wood object. While the cutter head described in said previous application has proved satisfactory under certain operating conditions it is less satisfactory under higher speed applications and accordingly an object of this invention is to provide a cutter suitable for operation within a broader speed range.

A more specific object of the present invention is to provide an improved cutter head of the general type described in the previous application but which cutter head will be inherently in balance both statically and dynamically at all times.

An additional obect is to provide an improved construction in a rotary cutter for flaking and surfacing wood, in accordance with the method described in application Serial No. 627,687, through which improved construction it will be possible to have a greater range of speeds at which the work can be fed past the cutter relative to the particular rotational speed desired for the cutter, while producing the same desired and specified length of wood flake in the flake-cutting operation.

Another object of this invention is to provide an improved flaking and surfacing cutter head having cutting or slicing knives which can be adjusted for varying the thickness of the flakes if desired.

A related object of the invention is to provide a rotary cutter head in which the knives will be arranged in a plurality of helical-spiral knife lines and in which the knives will be equipped with special means for cutting the ends of the flakes during the slicing operation when thicker flakes are desired for pulping or other purposes.

The particular improvements in the cutter head provided by the present invention, through which these additional objects and further advantages are attained, will be described briefly with reference to the accompanying drawings, wherein:

Figure 1 is an elevation showing the working face of an improved rotary flaking and surfacing cutter head made in accordance with the present invention;

Figure 2 is a side elevation of the cutter head taken on line 2—2 of Figure 1;

Figure 3 is an enlarged fragmentary elevation of the working face of the cutter head of Figure 1 showing one of the slicing knives, with a portion of the knife and adjacent portion of the cutter head body broken away for clarity;

Figure 4 is a side elevation of the same knife taken on line 4—4 of Figure 3;

Figure 5 is a section on line 5—5 of Figure 3;

Figure 6 is a perspective view of one of the slicing knives of the cutter head showing the same entirely removed from the cutter head body, and with the scoring spur removed from the knife;

Figure 7 is a perspective view of the same knife taken from the opposite side and with the scoring spur removed;

Figure 8 is an elevation of the outside face of the scoring spur of the knife of Figures 3 and 4, showing the scoring spur by itself and drawn to a much larger scale;

Figure 9 is a view of the same scoring spur showing the opposite or inside face of the same;

Figure 10 is a further side elevation of the same scoring spur taken from the left of Figure 8 and thus on the line indicated at 10—10 in Figure 8;

Figures 11, 12, 13 and 14 are small diagrammatic views indicating how similar cutter heads can be made so as to have three, four, five and six identical helical-spiral knife courses, each extending 120°, 90°, 72° and 60° respectively on the periphery of the cutter head body, in place of the two helical-spiral courses of 180° each shown in Figure 1;

Figure 15 is an elevation, taken from the rear side of the cutter head, drawn to a smaller scale, and more or less diagrammatic, showing a hood over the cutter head, illustrating the cutter head in the operation of cutting a flat surface on a peeled log while producing the desired wood flakes from such cutting, the two helical-spiral courses of the slicing knives on the head corresponding to those of the cutter head illustrated in Figure 1, and being indicated in broken lines; and

Figure 16 is a corresponding diagrammatic plan view of the operation shown in Figure 15, with the hood shown in section for clarity.

The cutter head, indicated in general by the reference character 10 in Figures 1 to 5 inclusive, is secured to the end of a driven shaft 11, which shaft is supported and driven at a rapid predetermined speed by suitable means (not shown), the direction of rotation of the shaft and cutter head being indicated by the arrows in Figures 1 and 2.

The periphery of the main body of the cutter head 10 is formed with two identical and oppositely positioned volute portions 12 and 13, each extending for 180° on the periphery, with the radius in each peripheral portion decreasing in the direction opposite the direction of rotation of the cutter head. Equally spaced, identical knife slots 14 extend radially inwardly from the periphery in each of the peripheral portions 12 and 13, there being eight such knife slots in each peripheral portion in the cutter head illustrated in Figure 1. Each of these knife slots accommodates the mounting end of a cutter knife 15, the knives being all identical.

Each knife 15 has an inner mounting end 16 (see particularly Figures 6 and 7), substantially rectangular in cross section, the thickness of which is less than the width of the slots 14. Preferably one wall of each slot 14 is corrugated, as shown at 17 in Figures 1, 2 and 3, the corrugations being substantially parallel to the axis of the cutter head, and the adjacent face 16' of the mounting end

of each knife, (as shown best in Figure 7), is correspondingly corrugated so that the engagement of the corrugated surfaces will aid in holding the knives firmly and steadily in place in their slots. The corrugated wall **17** of each knife slot **14** is also formed with a recess **18** (Figures 3 and 5) for receiving a key **19** carried in the recess **20** (Figure 7) provided in the corrugated face **16'** of the mounting portion of the knife. The key recesses **18** and **20** and the key **19**, as shown in Figures 3, 5 and 7, are arranged at right angles to the corrugations in the face **16'** of the mounting portion of the knife and the corrugations in the wall **17** of the knife-receiving slot. The mounting portion **16** of the knife is also provided with a threaded recess **21** on its opposite face (Figure 6) for receiving the threaded stem of a set screw **22** (Figures 3, 4 and 5). Thus, when the knife **15** is set in place with the key **19** in the recesses **18** and **20** and the set screw **22** is rotated until its head presses outwardly against the opposite wall of the knife slot **14** (as shown in Figure 3) the knife will be firmly though removably mounted in its slot in the cutter head. The set screw **22** preferably is formed with a hexagonal or other suitably shaped head for convenient engagement by a wrench.

Other means may be used for securing the knives in place on the cutter head, but the means shown and described is known to be a practical and satisfactory way for mounting knives in a rotating cutter and is considered a preferred manner of doing so in the carrying out of the present invention. It would also be possible to have the knives permanently secured in the cutter head and the knives might even be made integral with the main body of the cutter head. However, having the knives removably mounted is regarded as more satisfactory, for obvious reasons.

Each knife **15** has a substantially flat bottom or work-engaging face **23** (Figures 4, 6 and 7) and a sloping, preferably partially concave, upper face **24**, which faces meet to form the cutting edge **25** of the knife. Preferably the cutting edge **25** is finished with a strip of stellite alloy, or other suitable hard metal, to afford longer resistance to wear. The knives optionally are also provided with removable scoring spurs **26**, the nature and purpose of which will be described later.

The cutting edges **25** of the successive knives in each volute peripheral portion of the cutter head body, and thus the cutting edges of the knives from A1 to A8 inclusive in each of the two peripheral portions **12** and **13** of the cutter head illustrated in Figure 1, extend in planes perpendicular to the axis of the cutter head and these planes intersect the cutter head axis successively at equally spaced distances along the axis in an outward direction, i.e. towards the work. Consequently, since the knives from A1 to A8 inclusive in each group are mounted on such volute peripheral portion, the radius of which decreases, and since the successive knife edges of the knives of each group are located progressively outwardly towards the work, the knives in each group are located in a helical-spiral course, extending in a direction opposite the direction of rotation of the cutter head, constantly approaching 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 rotational axis, in the nature of a helix. Thus the knives can be described as located in radially-retreating, axially-advancing courses, as indicated by the broken lines *x* and *y* in Figure 1. The cutting edges of the corresponding knives in the two courses, for example the cutting edges of the two opposite knives A1, are located in the same plane; the cutting edges of the next two opposite knives A2 are located in a second plane, and so on; and the planes of the successive opposite pairs of knives are equally spaced. The last knife in each course, thus the knives A8 of Figures 1 and 2, extend beyond the work-engaging face of the cutter head, and thus the work or wood moves past the work-engaging or outer face of the cutter head as the final flat surface is produced on the wood. Since the opposite knives of each pair are located in the same plane and also are located at equal radial distance from the axis of rotation, the cutter head will be in balance both statically and dynamically. In the example illustrated, the length of the cutting edge **25** of each knife is made equal to the difference between the radial distances at which the extremities of each volute peripheral portion **12** and **13** are located from the cutter head axis.

The operation of the cutter head as so far described, and the manner in which the special desirable wood flakes are obtained while the desired flat surface simultaneously is being cut along the wood, for example on a log, will be explained now with reference to Figures 1, 15 and 16. The size of the cutter head will depend upon the size of the log to be cut or the width of the surface to be cut in the wood, but from Figure 1, in which the log L is indicated in broken lines, it will be understood that the cutter head, and, more specifically the helical-spiral courses of the two opposite sets of slicing knives, must extend beyond the edge of the surface to be cut. In other words, the inner radius of each of the last knives A8 in each course must at least be greater than half the width of the surface to be cut. In Figures 15 and 16 the flat surface which is being cut along one side of the log by the device is indicated at **40**, this flat surface being cut as the log is moved longitudinally past the rotating cutter head in a direction perpendicular to the axis of the cutter head.

Assuming that the axis of the cutter head remains fixed while the log moves longitudinally during the cutting, (although it will also be possible, though less practical, to have the axis of the rotating cutter moved with respect to a stationary log), the relative longitudinal movement of the log must correspond to the rate at which the cutting takes place. If, for example, the cutting edge **25** of each knife **15** is one and one-half inches long (and the peripheral portions of the body of the cutter head are formed accordingly so that each helical-spiral knife course approaches the axis of rotation one and one-half inches during 180° rotation of the cutter head), the lengthwise movement of the log should be not more than three inches for each complete rotation of the cutter head and should be exactly this amount to secure flakes of maximum length. Thus with the cutter head rotation at 1200 r.p.m. the travel of the log should be exactly 300 feet per minute. Each knife in one course would then in turn pass over the same portion of the log face during the first one and one-half inches of travel of the log and each knife in the other course would do the same during the travel of the log for the next one and one-half inches, with the result that a flat surface is left on the log. Obviously the feed rate of the log must be carefully synchronized with the rotational speed of the cutter head to obtain flakes of maximum length. If the speed at which the log is fed is reduced, the flake length will be less in proportion, but the thickness of the flakes will nevertheless remain constant. The thickness of the flakes will be determined by the difference in level between the successive knives in each helical-spiral course.

In actual operation a shield or hood preferably is placed over the cutter head, as indicated by the hood **38** in Figures 15 and 16, the hood being shown as having a discharging channel or spout **39** for the wood flakes. The log L moves in the direction indicated by the arrow Y.

Thus far the device of the invention has been described as having two identical groups of slicing knives each arranged in the essential and identical helical-spiral course. However, it is possible to carry out the invention with cutter heads having more than two such helical-spiral knife courses. Thus Figure 11 indicates how a cutter head **10** could be made with three such courses **34**. These courses would necessarily have to be each of the same length (and thus 120° in this case). The number and arrangement of the knives would have to be identical in each course, and furthermore the corresponding knives

in each course would have to be in the same plane. Obviously with such arrangement the cutter head would also be in balance statically and dynamically. With this arrangement, as indicated in Figure 11, the speed of travel of the log past the cutter head could then be three times the length of the cutting edges of the knife for each rotation of the cutter head, instead of twice the length of the cutting edges for each rotation, as in the case of the cutter head in Figure 1 where there are only two such helical-spiral knife courses.

Similarly Figures 12, 13 and 14 indicate cutters having four, five and six helical-spiral courses (indicated at **35**, **36** and **37** respectively), making possible greater relative speed of travel of the log with respect to the speed of rotation of the cutter head. Each knife, with its cutting edge and spur, cuts arcuately across the grain of the wood while the wood is moving longitudinally and thus the wood flake cut by each knife will have its ends cut in spiral curves or curves of constantly increasing radius. In every instance each helical-spiral course on the cutter head must be identical and the corresponding knives in each course must be in the same plane. Consequently in every such case the cutter head will be statically and dynamically in balance.

The wood flakes cut by any such cutter head under such conditions are uniform, are of uniform strength, of novel shape, and have the desired advantage of being sliced substantially across the grain of the wood. It is known that the slicing of wood across the grain or obliquely to the grain reduces the damage to the fibers which occurs when the slicing takes place longitudinally or parallel to the grain. The slicing action performed by such cutter heads results in flakes wherein the flexing of the flakes is mainly parallel with the grain. The flakes have spiral ends which are new and novel.

For pulping purposes it may be desired to have relatively thick flakes cut by the flaking and surfacing machine of this invention. In such case the cutter head is so constructed that the difference in level between the consecutive knives in each course will be greater. However, if relatively thick flakes are desired it is then important to have additional means for scoring or severing the spiral ends of the flakes. For this purpose each knife in each course, with the exception of the final knife in each course, is equipped with a special removable scoring spur **26** shown in Figures 2, 3, 4, 8, 9 and 10.

Each scoring spur **26** has a pair of side bevels **28** and **28'** (Figure 8) on its front face to enable it to fit into a dovetail groove **27** (Figures 3, 6 and 7) on the peripheral face of a knife. The rear face of the scoring spur at the bottom is formed with a pair of beveled surfaces **29** and **29'** (Figure 9) which combine with the bottom edge of the front face to form a scoring or cutting edge sloping downwardly from each end to a pointed tip **30**. These scoring spurs preferably are made from suitable hardened metal.

Each knife has a threaded aperture **32** leading from a slot **31** (Figures 3 and 6) to the dovetail groove **27**. The threaded aperture carries a set screw **33** which holds the scoring spur **26** in its dovetail groove **27**. Loosening the set screw **33**, as apparent from Figure 3, enables the scoring spur **26** to be adjusted, or, when not needed, to be removed entirely from the knife. The slot **31** permits access to the head of the set screw **33** for tightening or loosening the set screw.

Thus the addition of the scoring spurs enables relatively thick flakes to be sliced without any excessive fiber damage or detriment to the flakes along their spiral-shaped severed ends. The wood mass or log which is being cut can be supported and moved longitudinally by any suitable means such as a traveling carriage, a traveling bed, or feed rolls operating in the conventional manner, with the feed speed properly regulated and, if the maximum length is desired for the flakes, the feed speed must be synchronized with the operating speed of the cutter head

as previously explained. Modifications would be possible in the shape, arrangement and mounting of the scoring spurs without departing from the principle of this particular feature of the invention, and, as previously indicated, it would be possible to have other changes in the construction of the cutter head, in the construction of the knives, and in the mounting of the same. However, it is essential that the knives be identically arranged, in a plurality of identical helical-spiral courses, in order that the rotating cutter head will always be in balance for maximum smoothness of the cutting operation while the special wood flakes and the flat surface along the wood are being produced.

I claim:

1. In a device for producing special wood flakes while cutting a flat surface on wood, a rotating cutter head, a series of identical, equally spaced, slicing knives carried on the periphery of said cutter head and extending outwardly therefrom, said knives having cutting edges extending perpendicular to the axis of rotation of said cutter head, said knives arranged in a plurality of identical, radially retreating axially advancing courses, each course extending part way around the periphery of said cutter head in a direction opposite the direction of rotation of said cutter head, the number of knives in each course being the same and the corresponding cutting edges of the knives in each course located in the same plane perpendicular to the axis of rotation, whereby, when the wood to be cut is brought into contact with said cutter head and moved longitudinally in a direction perpendicular to said cutter head axis at a rate of speed properly synchronized with the speed of rotation of said cutter head, said knives will produce wood flakes of identical thickness and length, having spiral ends, while cutting a flat surface along the wood.

2. The combination set forth in claim 1 with the addition of a scoring spur carried by each knife except the last knife in each course, said scoring spurs extending forwardly into the work from the peripheral edges of said knives for cutting the arcuate ends of said flakes.

3. In a device for producing special wood flakes while cutting a flat surface on wood, a rotating cutter head having a main body, the periphery of said main body divided into a plurality of identical volute peripheral portions with the radius in each portion decreasing in the direction opposite the direction of rotation of the cutter head, a series of identical, equally spaced, slicing knives mounted on said peripheral portions, and having cutting edges extending outwardly therefrom, said cutting edges of said knives extending perpendicular to the axis of rotation of said cutter head, the knives on said peripheral portions arranged in identical, forwardly leading paths and thereby positioned in a plurality of radially retreating, axially advancing courses, the number of knives in each course being the same, and the corresponding cutting edges of the knives in each course located in the same plane perpendicular to the axis of rotation, whereby, when the wood to be cut is brought into contact with said cutter head and moved longitudinally in a direction perpendicular to said cutter head axis at a rate of speed properly synchronized with the speed of rotation of said cutter head, said knives will produce wood flakes of identical thickness and length, having spiral ends, while cutting a flat surface along the wood.

4. The combination set forth in claim 3 with the extent to which the radial distance from the cutter head axis to the periphery becomes decreased in each of said peripheral portions on said main body of said cutter head being equal approximately to the length of the cutting edge of each knife.

5. In a device for producing special wood flakes while cutting a flat surface on wood, a rotating cutter head having a main body, the periphery of said main body provided with a series of identical, equally spaced slots extending substantially radially inwardly from said pe-

riphery, slicing knives having mounting ends secured in said slots and having knife blades extending outwardly from said periphery, said knives so arranged that said blades will be positioned in a plurality of identical, radially retreating, axially advancing courses, said knife blades having cutting edges extending perpendicular to the axis of rotation of said cutter head, the corresponding knives in each course positioned the same radial distance from the axis of said cutter head and located in a common plane perpendicular to said axis, whereby the rotating cutter head will be in balance at all times, and whereby, when the wood to be cut is brought into contact with said cutter head and moved longitudinally in a direction perpendicular to said cutter head axis at a rate of speed properly synchronized with the speed of rotation of said cutter head, said knives will produce wood flakes of identical thickness and length, having spiral ends, while cutting a flat surface along the wood.

6. In a wood flaking and surfacing device, a rotating cutter head having a main body, the periphery of said main body divided into a plurality of identical volute peripheral portions with the radius of each portion decreasing in the direction opposite the direction of rotation of the cutter head, each of said peripheral portions provided with the same number of equally spaced slots extending substantially radially inwardly in said main body, identical slicing knives having mounting ends secured in said slots and having knife blades extending outwardly from said peripheral portions, the knives in each peripheral portion so arranged that their blades will be positioned in a forwardly leading path, the paths of the knife blades in said peripheral portions being identical, whereby the knife blades on said main body will be positioned in a plurality of identical, radially retreating, axially advancing courses, said knife blades having cutting edges extending perpendicular to the axis of rotation of said cutter head, the corresponding knives in each course positioned the same radial distance from the axis of said cutter head with their cutting edges located in the same plane, whereby the rotating cutter head will be in balance at all times.

7. In a wood flaking and surfacing device, a rotating cutter head having a main body, the periphery of said main body divided into a plurality of identical volute peripheral portions with the radius in each portion decreasing in the direction opposite the direction of rotation of the cutter head, each of said peripheral portions provided with the same number of equally spaced slots extending substantially radially inwardly in said main body, identical slicing knives having mounting ends removably secured in said slots and having knife blades extending outwardly from said peripheral portions, said knife blades having cutting edges extending perpendicular to the axis of rotation of said cutter head, the knives in each peripheral portion so arranged that the cutting edges of their blades will be positioned in a forwardly leading path, the paths of the cutting edges of the knife blades in said peripheral portions being identical, whereby the cutting edges of the knife blades on said main body will be positioned in a plurality of identical, radially retreating, axially advancing courses, the amount of radial decrease in each of said peripheral portions on said main body being equal approximately to the length of the cutting edge of each knife, and the corresponding knives in each course positioned the same radial distance from the axis of said cutter head with their cutting edges located in the same plane, whereby the rotating cutter head will be in balance at all times.

8. In a device for producing special wood flakes while cutting a flat surface on wood, a rotating cutter head having a main body, the periphery of said main body divided into a plurality of identical volute peripheral portions with a radius in each portion decreasing in the direction opposite the direction of rotation of the cutter head, each of said peripheral portions provided with the same number of equally spaced slots extending substantially radially in said main body, slicing knives having mounting ends secured in said slots and having knife blades extending outwardly from said peripheral portions, the knives in each peripheral portion so arranged that their blades will be positioned in a forwardly leading path, the paths of the knife blades in said peripheral portions being identical whereby the knife blades on said main body will be positioned in a plurality of identical, radially retreating, axially advancing courses, a scoring spur removably mounted on each knife, except on the last knife in each course, said scoring spurs extending forwardly into the work from the peripheral edges of said knives, the corresponding knives in each course positioned the same radial distance from the axis of said cutter head and located in a common plane substantially perpendicular to said axis, whereby the rotating cutter head will be in balance at all times and whereby, when the wood to be cut is brought into contact with said cutter head and moved longitudinally in a direction perpendicular to said cutter head axis at a rate of speed properly synchronized with the speed of rotation of said cutter head, said knives will produce wood flakes of identical thickness and length, having spiral ends, while a flat surface is being cut along the wood, and said scoring spurs will aid the freeing of the flakes by cutting the arcuate ends of the flakes.

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