Oct. 13, 1953 C. A. JOHNSON 2,655,319
WOOD CHIPPER DISK WITH RADIALLY ORIENTED KNIVES OF GRADUATED BEVELS

Filed Sept. 24, 1949 4 Sheets-Sheet 1

Fig. 1

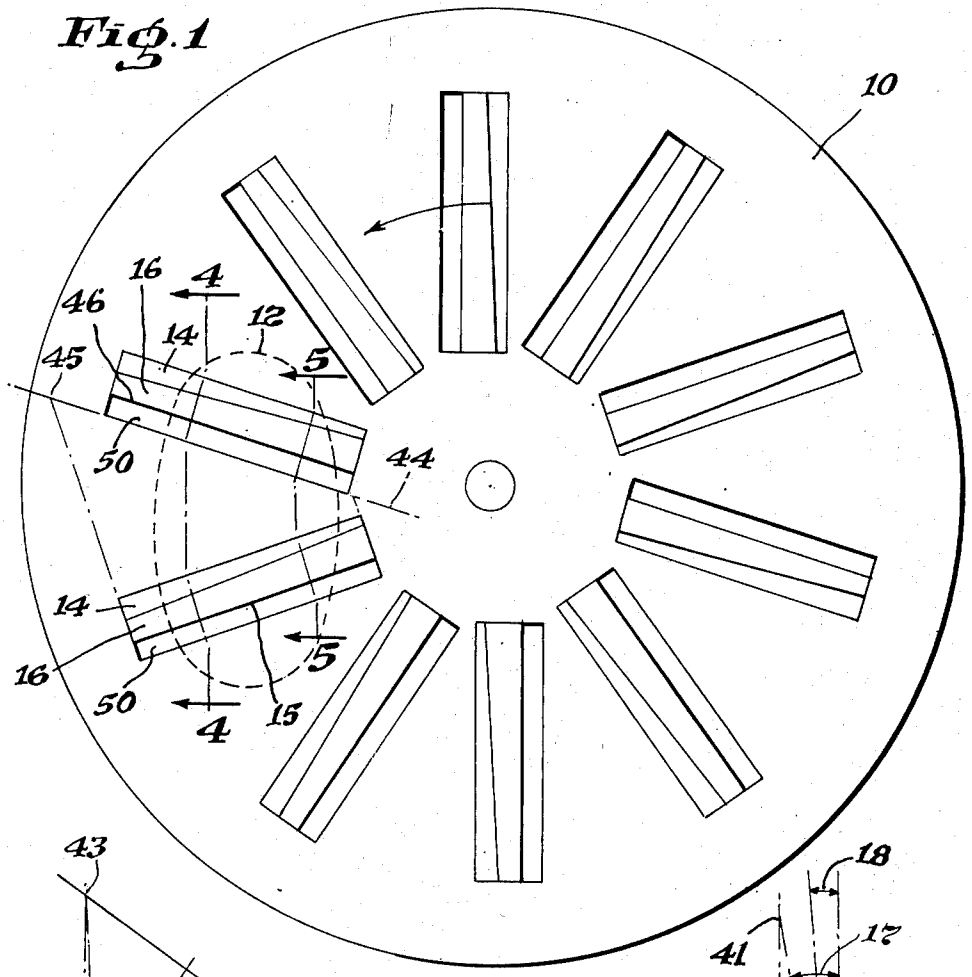


Fig. 2

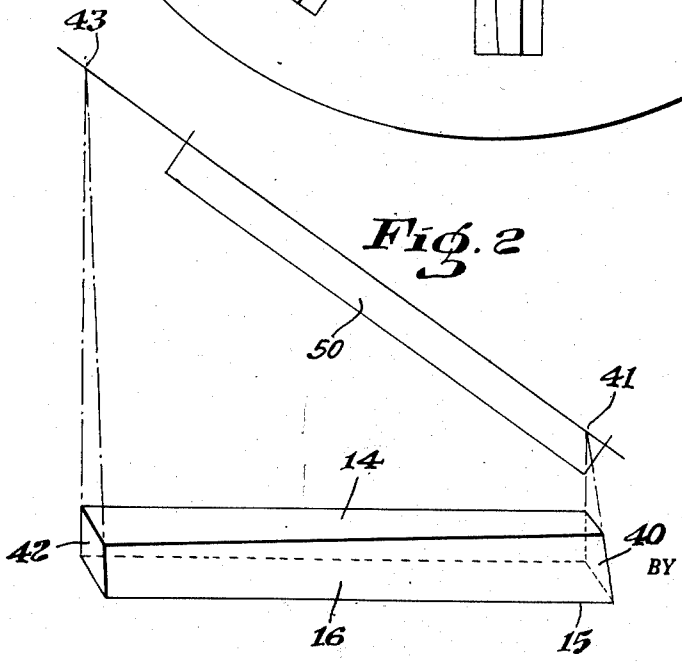
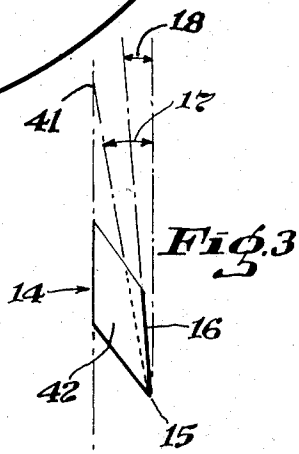


Fig. 3



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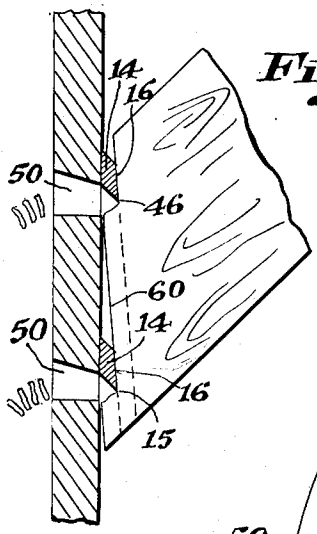


Fig. 4

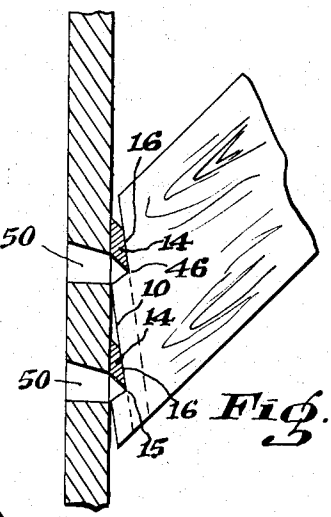


Fig. 5

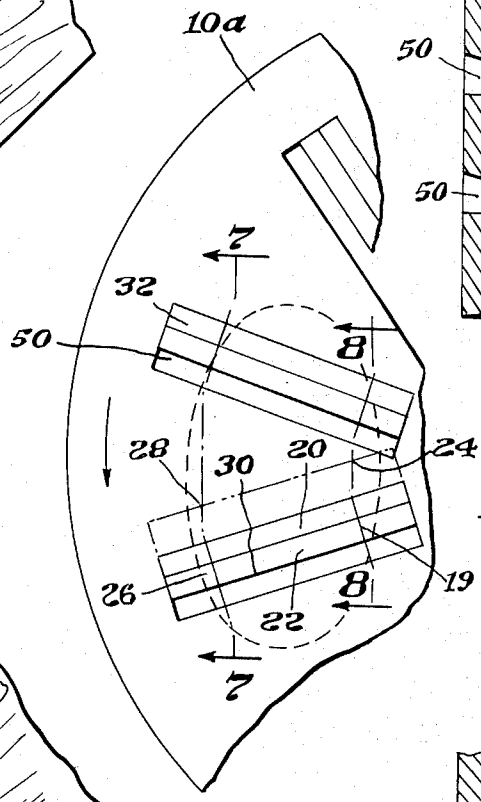


Fig. 6

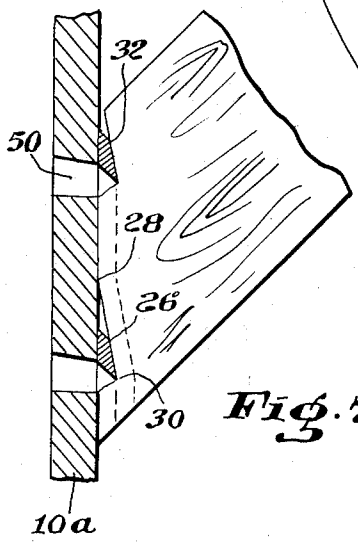


Fig. 7

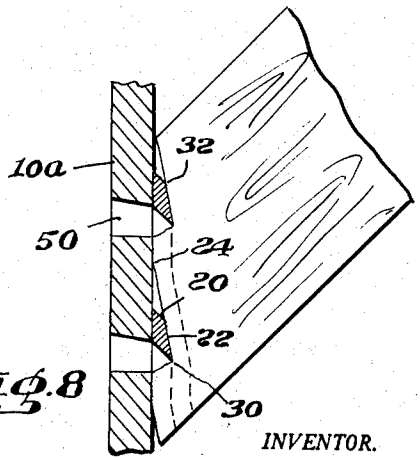


Fig. 8

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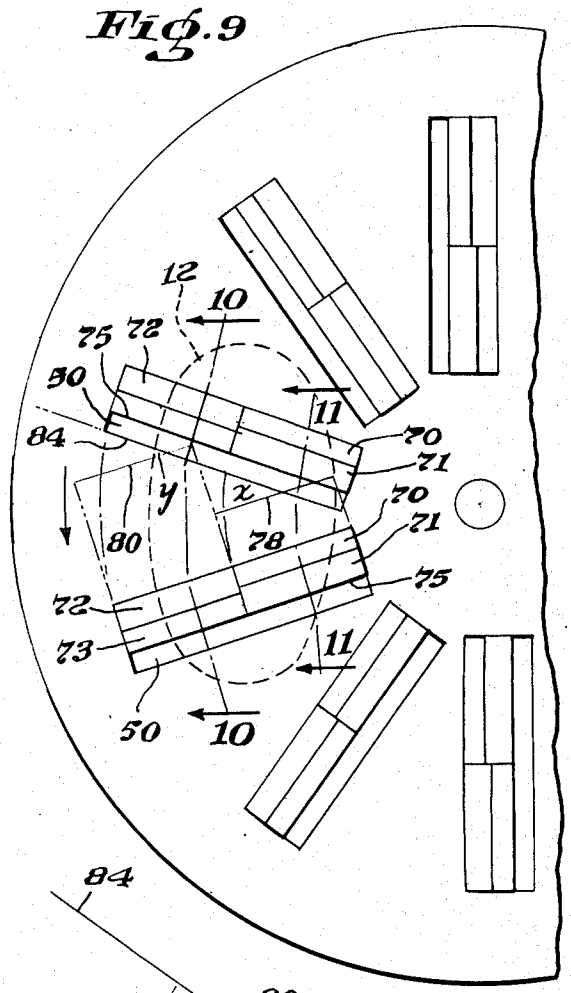
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Fig. 9



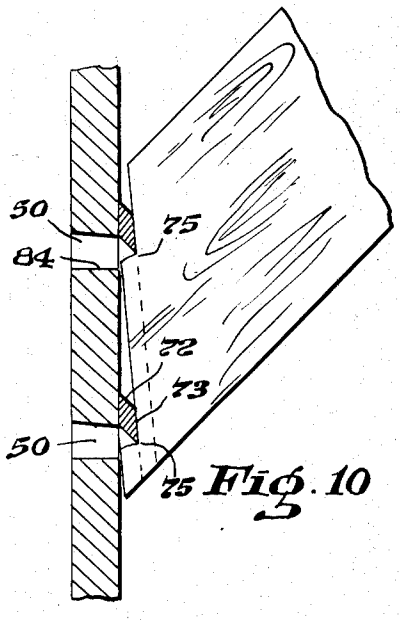


Fig. 10

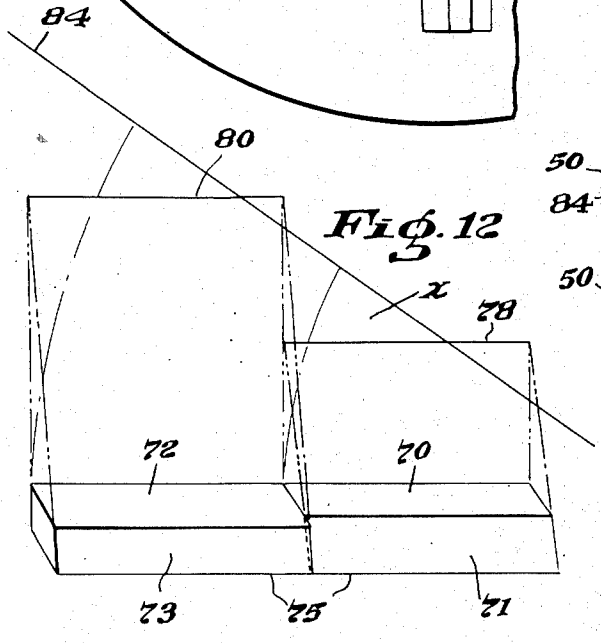


Fig. 12

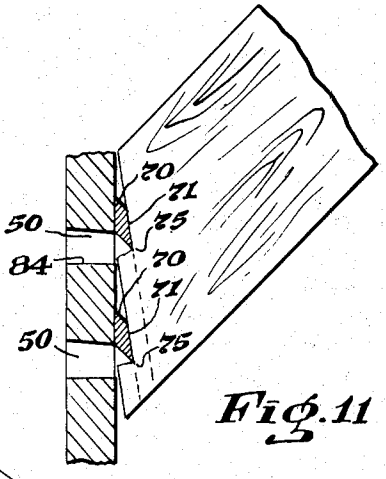


Fig. 11

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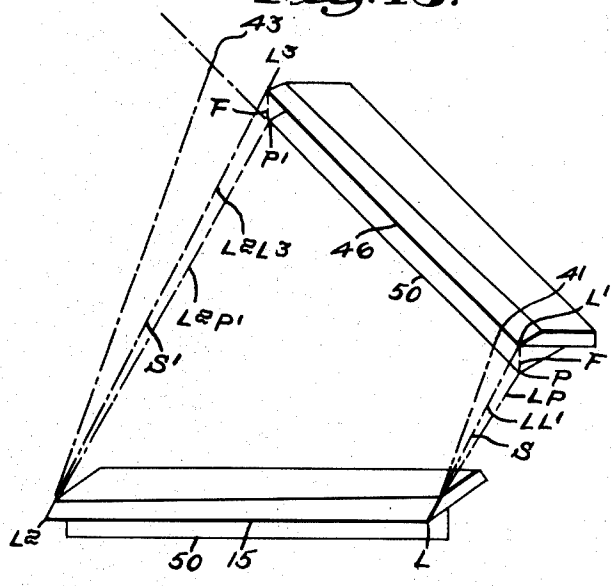
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WOOD CHIPPER DISK WITH RADIALLY ORIENTED KNIVES OF GRADUATED BEVELS

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Fig. 13.



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2,655,319

UNITED STATES PATENT OFFICE

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WOOD CHIPPER DISK WITH RADIALLY ORIENTED KNIVES OF GRADUATED BEVELS

Charles A. Johnson, Berlin, N. H.

Application September 24, 1949, Serial No. 117,676

5 Claims. (Cl. 241—92)

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This invention relates to wood chippers for reducing logs to chips in preparation for conversion into wood pulp.

As described in the September, 1948 issue of "The Paper Industry and Paper World," page 883, log chippers have become fairly standardized in the pulp industry, though they have been subject, from time to time, to a good deal of non-constructive criticism. A typical chipper is formed of a heavy steel disk having knives radially disposed in slots with their cutting edges projecting beyond the face of the disc. The back surface of each knife is mounted at an angle (e. g. 45°) to the face of the disc, while the angle of the cutting edge is a few degrees off parallel to the face of the disc, all as described in said article.

The chipper of this invention embodies a precisely defined departure in structure from previous chippers, involving different knife geometry, to obtain the advantages of an entirely new principle of log chipping operation.

The primary object of the invention is to provide a chipper, the output of which is better suited for use in chemical digestion than the output of the present-day chippers due to better knife action; but added features are the provision of a chipper which will be subject to less wear and will operate with less power consumption.

The improved output is due to an improved action of the log during the feed and cutting, whereby the wood is subjected to less mechanical stress, accomplished by a change in the geometry of the cutting knives. The improved action has shown itself of great advantage in the production of chips of better quality and more uniform in length, and in material reduction in the amount of sawdust, fines and "ends" (which must be screened from the chips before digestion), thereby increasing the yield so far as pulping is concerned.

While this invention may be incorporated in a knife chipper having any desired number of knives, for the purposes of convenience in description, the accompanying drawings illustrate a ten-knife chipper.

Fig. 1 represents a diagrammatic elevational view of the face of a log chipper disc having the knife geometry of this invention, and showing in dotted lines the relative position of a conventional chute opening;

Fig. 2 is an isometric view of the protruding portion of one of the knives of Fig. 1;

Fig. 3 is an end elevation of the outer end of one of the knives of Fig. 1;

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Fig. 4 is a cross-sectional view taken along the broken line 4—4 of Fig. 1;

Fig. 5 is a cross-sectional view taken along the broken line 5—5 of Fig. 1;

Fig. 6 is (for purposes of comparison) a fragmentary diagrammatic elevational view of the face of a conventional knife chipper;

Figs. 7 and 8 are cross-sectional views taken along the lines 7—7 and 8—8 of Fig. 6, respectively;

Fig. 9 is a view similar to that shown in Fig. 1 of a modified form of chipper knife construction;

Figs. 10 and 11 are cross-sectional views taken along the broken lines 10—10 and 11—11 of Fig. 9, respectively;

Fig. 12 is an isometric view, similar to that of Fig. 2, of the construction of knife utilized in the modified form shown in Fig. 9; and

Fig. 13 is an isometric view similar to that of Fig. 2, but viewing the blade from the inner end instead of the outer end and having certain construction lines imposed thereupon.

Reference 10 in Fig. 1 represents the face of a conventional knife disc of well-known construction, for example, similar to that shown in Ottersland Patent No. 2,299,248, dated October 20, 1942. Broken line 12 represents the relative position of the feeding end of a conventional log chute which may be inclined at an angle of say 45° to the face of the disc and adapted to hold and gravity-feed end-on logs to the chipper knives.

The knives 14 shown in Fig. 1 are distinguished from conventional knives in one vital respect, but are otherwise adapted for mounting on the disc 10 in radial fashion by any conventional known means with their cutting edges 15 extending along lines tangent to a circle having as an axis the axis of the disc.

The distinguishing knife feature is that, while conventional knives have a uniform angle of bevel from end to end, in the construction of my invention shown in Figs. 1–2 inclusive, the bevel surface, i. e., the outer surface of the knife extending backwardly towards the face of the disc, 16 is warped, i. e. the bevel is non-uniform throughout, progressing from a relatively sharp bevel at the inner end (at the right in Fig. 2) to a wider bevel at the outer end (at the left in Fig. 2) forming an angle of draw, i. e., an angle with the plane of revolution of the cutting edges, which progressively and uniformly decreases radially outwardly of the disc, being the larger angle 17 (Fig. 3) at the inner end, and the smaller angle 18 at the outer end.

The amount of warping is determined by the geometry of the parts so that the projection of the

cutting edge along the angle of draw will intersect the plane of the wear surface of the disc, which plane contains the leading edges of the disc chip slots, along a line non-parallel with its own cutting edge, and, preferably, parallel to the leading cutting edge of the following knife, and lying substantially beneath the cutting edge of the following blade and along a line of intersection which falls within the area of the chip slot which leads the following blade.

This principle and the resulting effects may be better understood by consideration first of the geometry of a conventional uniform bevel knife chipper disc having a non-varying angle of draw, which has, for this convenient purpose, been illustrated in Figs. 6–8. As shown in Fig. 8, at the inner end 19 of the knife 20 of Fig. 6, the plane of the uniform bevel surface 22 intersects the plane of the wear face of the disc 10*a* at 24, whereas at the outer end 26 of the blade 20, the plane of the bevel surface 22 intersects the plane of the wear face of the disc 10*a* at 28. The points 24 and 28 lie in a line which is parallel to the leading cutting edge 30 of the knife 20 and represented approximately by the dot and dash line shown in Fig. 6.

The same bevel is of course used on the following blade 32 with the resulting similar geometry.

Referring back again to Figs. 1–5, it will be seen that, in the construction there shown, the warping of the bevel surface produces the following result: At the inner end 40 of the knife 14, the projection of the cutting edge at the large angle of draw intersects the plane of the wear face of the disc at 41 (Fig. 2). At the outer end 42 of the knife 14, the projection of the cutting edge at the smaller angle of draw intersects the plane of the wear face of the disc at 43. The line 41—43 shown in Fig. 2 corresponds approximately to, but lies behind, the dot-and-dash line 44—45, shown in Fig. 1, a line of intersection, which is parallel to the leading cutting edge 46 of the following knife 14; and this line 44—45 is, of course, not parallel, but at an angle, to the cutting edge 15 of the leading knife 14.

The effect of this difference can be understood from a comparison between Figs. 4 and 5 and Figs. 7 and 8, in each of which a log is shown during the cutting operation.

With the conventional blades of Figs. 7 and 8, it will be seen that particularly at the outer end of the disc as shown in Fig. 7 a substantial area of the log between the point 28 and the leading end of slot 50 is in direct contact with the face of the disc where it is subject to friction and prevents further advance of the log until the disc 10*a* has rotated downwardly from the position shown in Fig. 7, so that the upper slot 50 will be opposite the point 28. During the time interval necessary for this movement to take place, both the knives must necessarily cut along cutting planes which are parallel to the face of the disc as shown by the dotted lines in Fig. 7 and in Fig. 8, since the normal pulling action or draw of the knives is opposed by the wear plate contacting this log area. Only when the slot 50 reaches the point 28 can further log advance take place, with the blade 32 then cutting along the plane of the broken line of Fig. 7 towards the bottom of the log.

In direct contrast, in devices of my invention, as shown by Figs. 4 and 5, the outer knife surface is disposed wholly discwards of the zone included by the varying angle of draw so that, both at the inner end and outer end of knives 14, the cut of the leading blade will be along a line 60, the angle of which is determined by the angle of draw, which will prevent contact of the log with the face of the disc and confine its contact to the properly angled bevel surface 16 of the blades. Due to the pulling action of the blades, the advance of the log will therefore be constant along the angle of draw, unopposed by the face of the disc, rather than intermittent.

Furthermore, keeping the face of the disc from brushing across the log in the area 60 will avoid mashing or "brooming" of the end of the log because of the intermittent forcible thrust against the face of the disc and will prevent wear of the wear surface.

In Fig. 13 there is shown a perspective view of the inner end of two of the blades showing the points 41 and 43 of Fig. 2 and showing the cutting edge 15 of the leading blade and the cutting edge 46 of the following blade. On this figure, I have constructed dotted line LL^1 which represents the distance between the inner end of the leading blade cutting edge 15 and the inner end of the following blade cutting edge 46.

From the point L^1, I have dropped a perpendicular to the plane of revolution of the leading edge of the chip slot 50, that is, to the point P. Angle LL^1P is thus a right angle. I have then also constructed line LP.

Similarly, at the outer end, I have constructed the lines L^2L^3, projection L^3P^1 and L^2P^1, the points L, L^1, L^2, L^3 all lying in the same plane of disc revolution and the point P^1 lying in the same plane of disc revolution as point P. The lines L^3P^1 and L^1P are thus of equal length corresponding to the distance between the plane of revolution of the points L, L^1, L^2 and L^3 and the plane of revolution of the face of the disc, i. e. of the leading edge of the chip slot, 50.

The angles PLL^1 and $P^1L^2L^3$ respectively correspond substantially to the angles of draw 17 and 18 of Fig. 3, though they differ slightly because the point 41 is at a slightly greater radial distance from the disc axis than the point L^1 and the point 43 is at a slightly greater radial distance from the disc axis than the point L^3; but the difference in the angles is extremely minute.

Since the lines LL^1 and L^2L^3 represent the spacing between points on the leading and following cutting edges at equal radius, they may be represented as S and S^1 respectively. Likewise, since the lines L^1P and L^3P^1 represent the distance in feed from one cutting edge to the other, they may be both represented as F. The angle of draw may, therefore, be mathematically calculated for any disc chipper from the designed values for S and F, being the angle whose cotangent $=S/F$ at the inner blade end and uniformly decreasing as S increases to S^1 along the cutting edge 15 until at the outer end of the blade, it is the angle whose cotangent $=S^1/F$.

By this means substantially the precise angle of draw may be mathematically calculated.

Because of the more complicated manufacturing, preparation and/or maintenance requirements in the case of a warped bevel surface on the chipper knives, satisfactory results can be obtained by utilizing instead of a warped bevel, a graduation of bevels. The latter can be most easily achieved by utilizing composite knives, each knife being formed of a plurality of blades having their cutting edges aligned, but each of the aligned blades having a different bevel.

Such a construction having two blades is shown in Figs. 9–12, wherein each knife is made up of

an inner blade 70 and an outer blade 72. The inner blade as shown has a surface 71 of uniform sharp bevel, whereas the outer blade 72 has a surface 73 of uniform wider bevel, collectively forming the leading cutting edge 75. The plane of intersection of the bevel surface 71 with the plane of the wear face of the disc is therefore along a line 78 parallel to the cutting edge 75, whereas the line of intersection of the plane of the bevel surface 73 with the plane of the face of the disc is along a line 80, also parallel to the cutting edge 75. Both lines of intersection extend beyond the leading edge 84 of the following slot 50. In this construction, most of the areas of the log will not touch the wear face of the disc and the only obstruction to advance of the log by the face of the disc is in two small triangular areas, the first defined by the leading edge 84 of the following slot 50, the line 78 and a line perpendicular to line 78 dropped from line 84 to the outer end of line 78, indicated in Figs. 9 and 12 as x. The second is defined by the leading edge 84 of the following slot 50, the line 80 and the edge of the log being fed, indicated in Fig. 9 as y. These areas are so small in comparison with the total area of the wear surface between the knives that substantially the advantages of the construction of Fig. 1 are obtained, in contrast with the wholly inferior results of the conventional construction illustrated by Fig. 6, and without the complication of maintaining a sharp cutting edge on a warped bevel surface.

I claim:

1. In a rotatable planar chipper disc having cutting knives protruding from the face of said disc providing leading and following straight cutting edges diverging outwardly from the center of said disc at an acute angle to each other and lying in a common plane of revolution, and a slot through the disc adjacent the cutting edge of each knife, for cutting material fed end-on toward the disc at an angle to the plane of revolution of said cutting edges, that improvement which comprises having the outer surface of each knife extending backwardly from its cutting edge as a surface formed of a series of straight lines intersecting the line of the cutting edge at equal angles and inclined axially backwardly towards the face of said disc, the lines spaced radially outwardly having decreased inclination relative to the lines spaced relatively inwardly along said cutting edge, said outer surface forming with another surface of the knife its cutting edge, and the angle of inclination of said lines from the plane of revolution of the cutting edge forming at the cutting edge a straight-sided angle of draw which is larger adjacent the inner end of the knife than adjacent the outer end thereof, and being such that at least a substantial portion of said straight lines distributed radially along said cutting edge when extended enter the slot which lies adjacent the following knife beyond the leading edge of said slot the entire included zone of the angles of draw formed by said radially distributed straight lines which enter said slot being void between said cutting edges.

2. A rotatable planar chipper disc as claimed in claim 1, wherein each knife is constituted of a plurality of blades, each having a straight cutting edge, said blades being disposed end-to-end with their cutting edges aligned to form a composite knife, the straight lines forming the inclined surface of the inner blade lying in one plane, which intersects the plane of revolution of the leading edge of the slot adjacent the following blade along a straight line intersecting the leading edge of the slot, and the straight lines forming the inclined surface of the outer blade lying in another less inclined plane which intersects said slot edge plane of revolution along another straight line intersecting the leading edge of said slot.

3. In a rotatable planar chipper disc having leading and following straight cutting edges diverging outwardly of said disc at an acute angle to each other and lying in a common plane of revolution spaced from the face of the disc and chip slots extending through the disc adjacent each cutting edge, that improvement which comprises having the leading cutting edge-forming outer surfaces extending backwardly towards the next following cutting edge, forming at said leading cutting edge, with said plane of revolution, a straight sided angle of draw which decreases progressively outwardly of said leading cutting edge, said angle of draw at any given point along said leading cutting edge being substantially that angle whose cotangent=S/F, where S represents the distance by which said leading cutting edge leads said following cutting edge at the disc radius of said given point and F represents the distance between the plane of revolution of the cutting edges and the plane of revolution of the leading edge of the chip slot adjacent the following blade, the entire included zone of said angle of draw between said cutting edges being void.

4. In a rotatable planar disc having cutting knives protruding from the face of said disc providing leading and following straight cutting edges diverging outwardly of said disc at an acute angle to each other and lying in a common plane of revolution, and a slot through the disc adjacent the cutting edge of each knife, for cutting material fed end-on toward the disc at an angle to the plane of revolution of said cutting edges, that improvement which comprises having the outer surface of each knife extending backwardly from its cutting edge as a surface formed of a series of straight lines intersecting the line of the cutting edge at right angles and inclined axially backwardly towards the face of said disc with decreasing inclination progressively radially outwardly along said cutting edge, said outer surface forming with another surface of the knife its cutting edge, and the angle of inclination of said lines from the plane of revolution of the cutting edge forming at the cutting edge a straight-sided angle of draw which uniformly progresses from a larger angle adjacent the inner end of the knife to a smaller angle adjacent the outer end thereof, and being such that said straight lines extended enter the slot which lies adjacent the following knife along a substantially straight line falling behind the leading edge of said slot and substantially parallel to the cutting edge of the following knife, and every surface point of the knife and disc which lies between the cutting edges of said knives lying wholly discwards of the zone included between said straight lines and the plane of revolution of said cutting edges.

5. In a rotatable planar chipper disc having leading and following straight cutting edges diverging outwardly of said disc at an acute angle to each other and lying in a common plane of revolution spaced from the face of the disc, and chip slots extending through the disc adjacent each cutting edge, that improvement which comprises having the leading cutting edge-forming outer surface extending backwardly towards the next following cutting edge, forming at said lead-

ing cutting edge, with said plane of revolution, a straight-sided angle of draw which decreases progressively outwardly of said leading cutting edge, said angle of draw at any given point along said leading cutting edge being an angle which is less than that angle whose cotangent=S'/F but does not exceed approximately that angle whose cotangent=S/F, where S' represents the distance (in the plane of cutting edge revolution) by which said leading cutting edge leads the leading edge of the chip slot adjacent said following cutting edge at the disc radius of said given point, S represents the distance by which said leading cutting edge leads said following cutting edge at the disc radius of said given point and F represents the distance between the plane of revolution of the cutting edges and the plane of revolution of the leading edge of the chip slot adjacent the following blade, the entire included zone of said angle of draw between said cutting edges being void.

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